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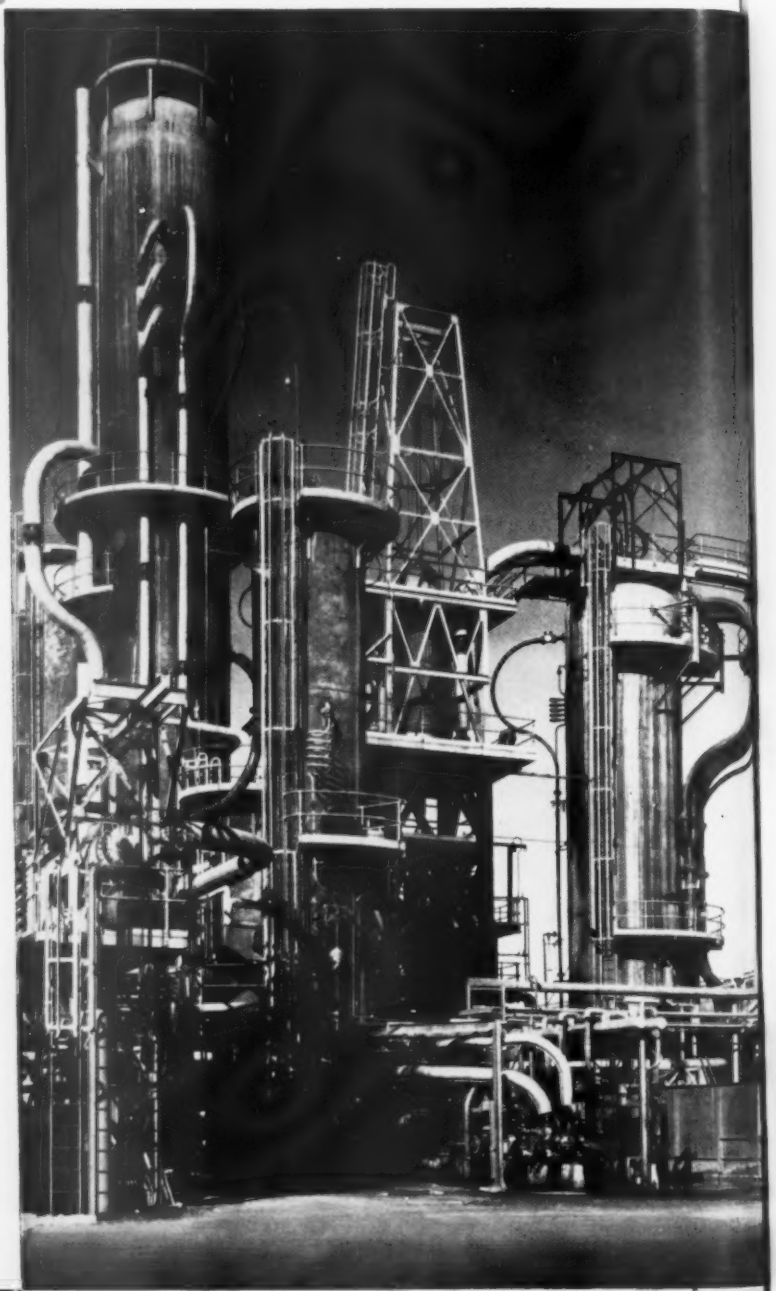

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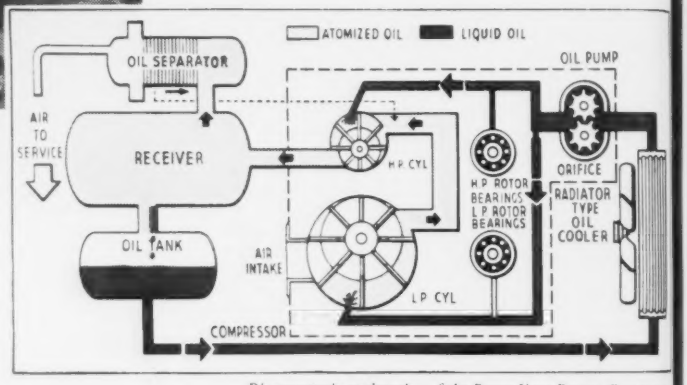

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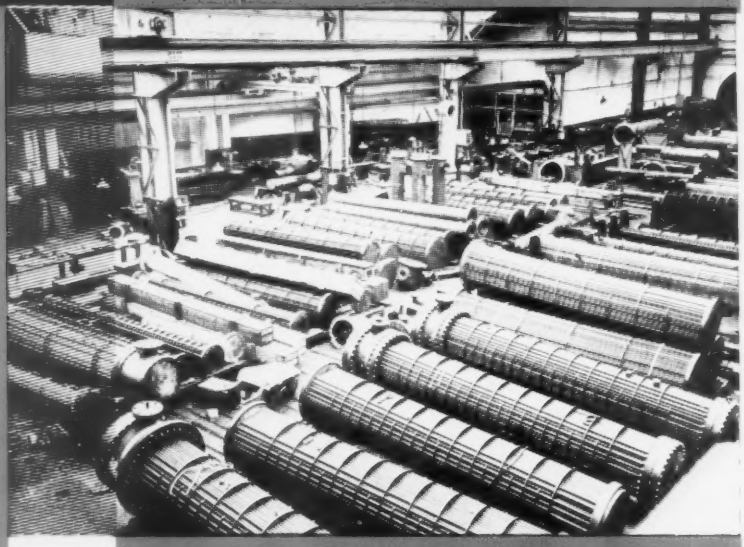

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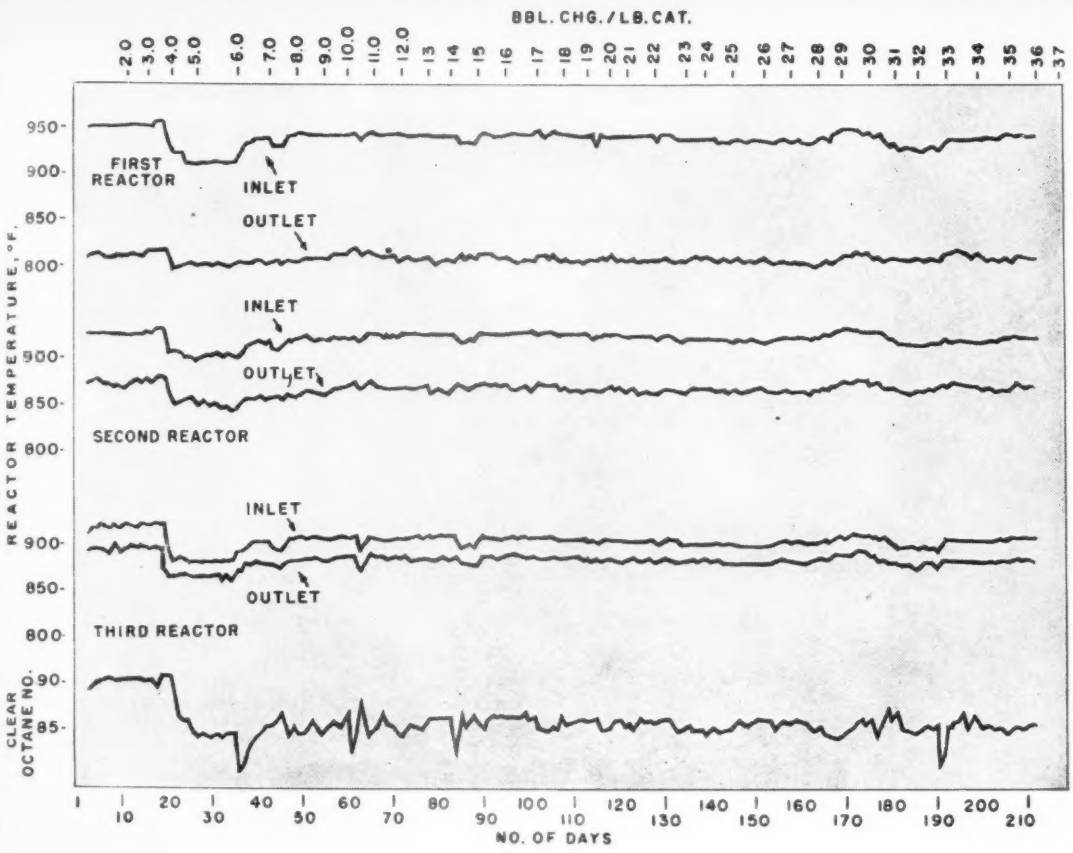

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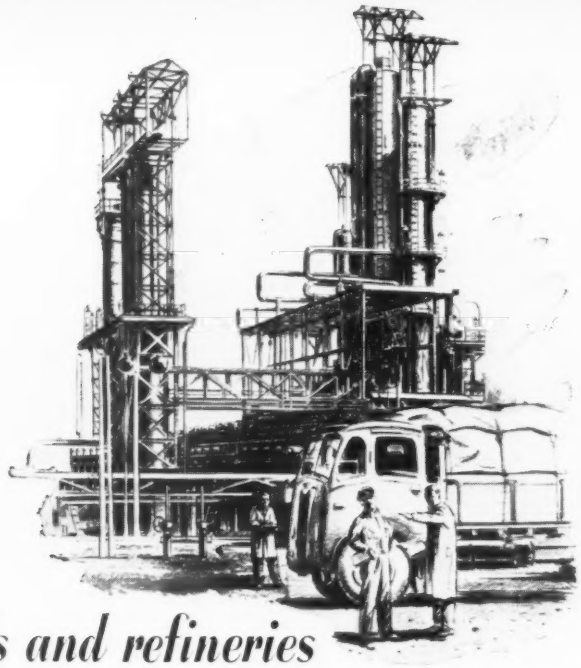

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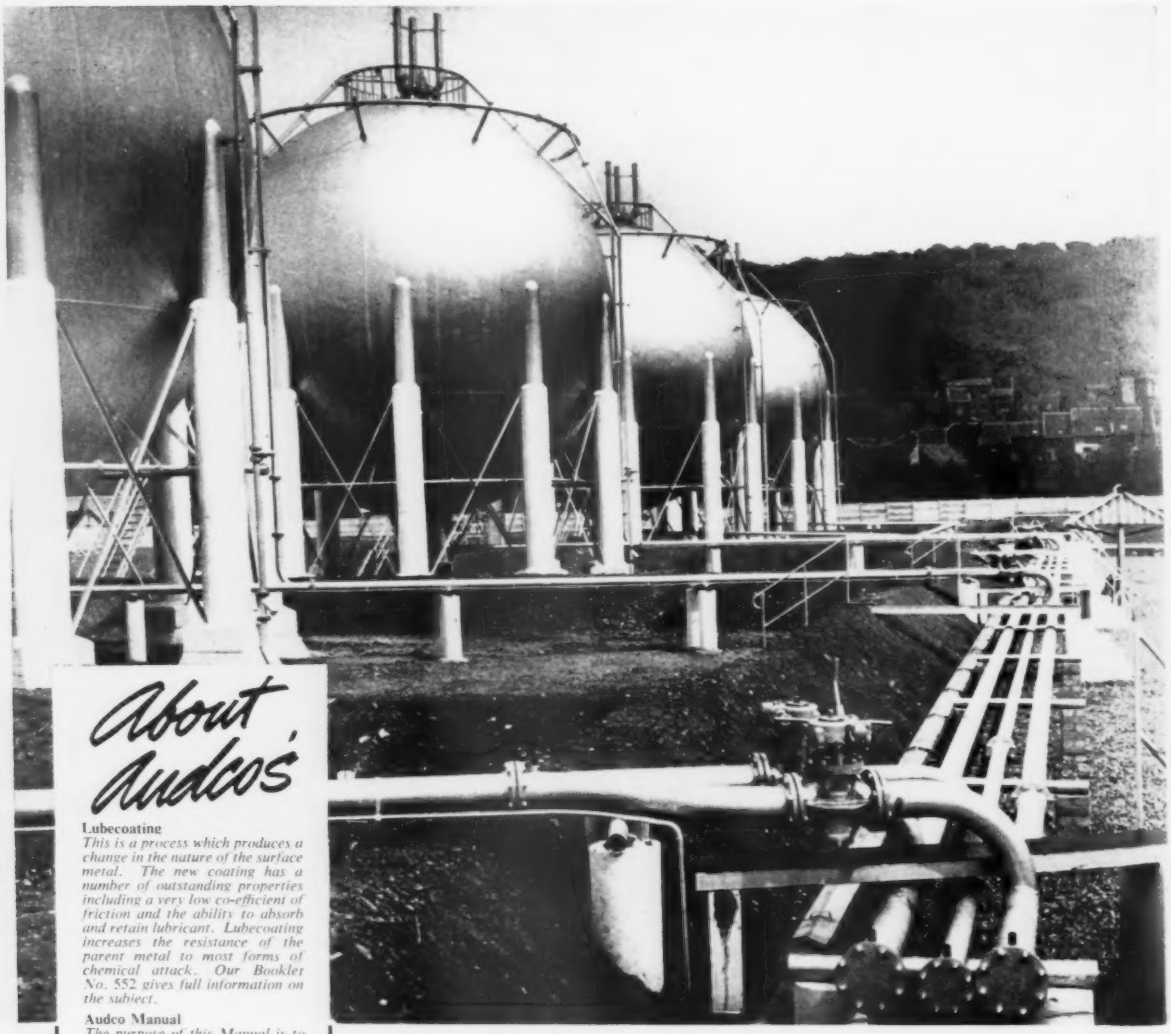

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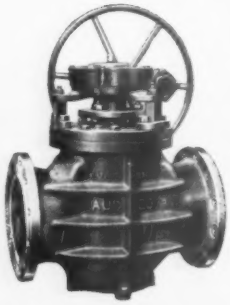

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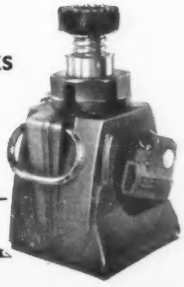

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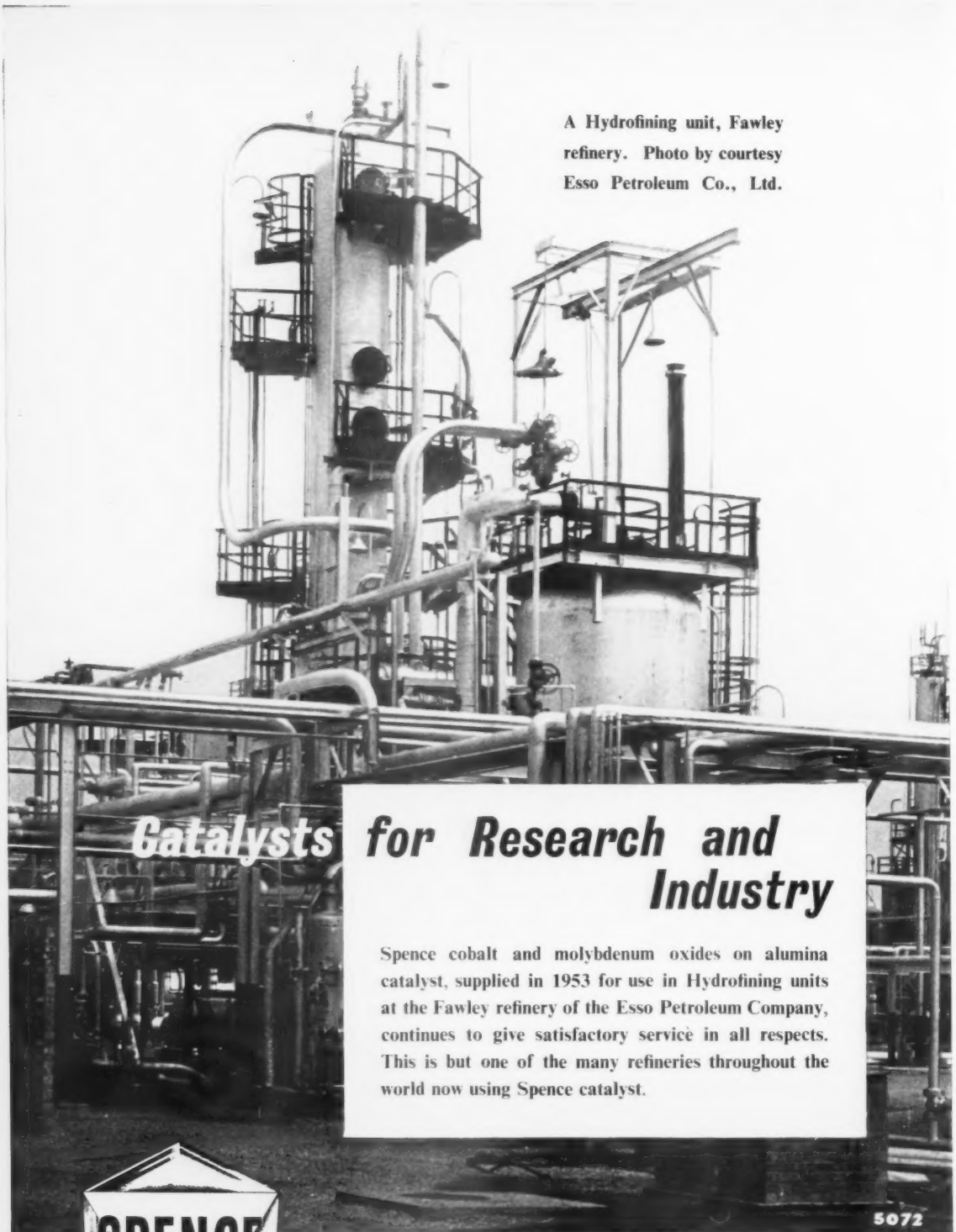

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The Price of Oil

By **R. A. R. PATTMAN** (*Member*)

It is something of a paradox that, while the price of oil is becoming an increasingly popular subject of discussion in the Press and by individuals and institutions outside the industry, it is nevertheless a comparatively neglected subject of discussion by spokesmen within the petroleum industry, even at such informal gatherings as those of the Economics and Operations Group of the Institute. Whatever may be the reasons for the relatively infrequent appearance of this subject on the programmes of industry gatherings in the past, it is the author's opinion that increasing discussion may lead to a clearer understanding, both within the industry and outside, of what is an immensely important aspect of the petroleum business. The pricing of the commodity sold determines the reward of all the technical, organizational, and financial efforts put into the industry; it provides the basis of all the economic planning and thus shapes the pattern and prosperity of the petroleum business for the future; it influences public acceptance of the performance of the industry as a whole, without which acceptance the industry would have no place in the world. It seems appropriate, therefore, that the Group should devote some attention to the matter.

This paper was read to a meeting of the Economics and Operations group of the Institute on 1 February 1956. Mr Pattman is on the staff of the Shell Petroleum Co. Ltd.

This paper deals principally with the pricing of oil as an international commodity, that is, with the pricing of bulk cargoes of the main products and of crude oils at the points of export and import where they cross national boundaries. Two points should be borne in mind throughout. First, petroleum is traded internationally in part as crude oils and in part as refined products, and it is important to make the distinction. Second, the world oil pricing pattern is not static but evolutionary—to talk about the world oil price "structure" is to give a wholly false impression of rigidity, inconsistent with the dynamic character of the industry.

A Unified World Market

Petroleum is the most important commodity in international trade. It moves freely across the oceans from several main supply sources and a number of tributary supply sources to almost every country of the world. There is thus a unified world market. Export and import prices in any part of the world bear an economic relationship to export and import prices in other parts of the world. There are no isolated sectors in the international field, although it is only too true, and regrettably so, that behind national frontiers governments can and do superimpose their own fiscal distortions upon the basic economic pricing of petroleum as a world market commodity.

Price Competition

This unified world market for international supplies of petroleum is a competitive market in which many sellers and many buyers participate. Although vertical integration and large scale enterprise are characteristic features of the industry there are also many non-integrated enterprises and thus many "arm's length" transactions between non-affiliated companies, and between companies and consumers, which have export or import prices attached to them. The concept of a self-contained completely vertically integrated enterprise is illusory. Even the largest international groups have marginal surpluses and deficits in the production, refining, transportation, and marketing phases of their operations, which are covered by market transactions with non-affiliated entities.

The international oil industry is composed mainly of large-scale mature enterprises, each of which is individually alive to the virtues of self-discipline and stability in its various activities, including pricing. Price competition in the international field is thus passive rather than hysterical: none the less it is real.

The general character of international oil pricing is peculiar to the industry and derives from its inherent technical, economic, and structural features. To the extent that it differs from the character of the pricing of other international commodities, the difference is attributable to differences in these basic features. World oil pricing is not monopoly pricing; it is not cartel pricing; not daily auction pricing. Its basic fabric consists of the bulk cargo prices for crude oils

and main products of the principal suppliers, for shipment from the principal world supply sources; such prices are now very generally published openly and regularly. These bulk cargo prices do not so much determine, as reflect, the state of the competitive market. They cannot be set arbitrarily.

The point at which competition is ultimately effective is the point where the supplier meets the consumer of finished products. Demand factors are of supreme importance.

Because of the inherent stability of what is now a powerful and established industry, conscious of its responsibilities, the effect of the play of demand and supply factors on basic cargo prices tends to be gradual, but the effect is nevertheless manifest. For example, it is the relatively rapid increase in world-wide demand by consumers for fuel oil that has occasioned the strengthening of basic cargo prices for fuel oil over the past year.

To take another example, which stresses the supply factor, it is the increasing potential of Middle East crude supplies since the end of the second world war that has resulted in the lowering of Middle East crude prices relative to Western Hemisphere crude prices over the last decade.

The Relativity of Prices

Relative prices and price movements are of greater significance than absolute prices and price movements in money terms. Individual products relative to each other, products as a whole relative to crude, crude oil or products at one world supply source relative to crude or products at other supply sources, petroleum relative to other commodities, prices in money terms relative to long-term trends in general price and cost levels—all these are categories of significant price relationships.

For instance, to take the crude oil example again, in 1945 the deepwater price of West Texas crude in the U.S. Gulf and the deepwater price of Arabian crude in the Persian Gulf were both a little over $1 a barrel. Today the West Texas crude price is nearly $3 a barrel, while the Arabian crude price is nearly $2 a barrel. Both prices in terms of dollars have risen appreciably over the ten year period, but it is the change in relationship that is significant.

To take another short-term example: the lowest published price of motor gasoline in cargo lots in the U.S. Gulf at the end of 1950 was 10c. per U.S. gallon ($4.20 per brl). Today it is 9.5c. ($3.99 per brl). The corresponding quotation for "C" grade fuel oil at the end of 1950 was $1.75 per barrel. Today it is $2.10. The ratio of these two gasoline: fuel oil prices has moved from 2.4:1 to 1.9:1.

The Mutuality of Price Relationships

Mutuality of price relationships is an important feature of world oil pricing. It is not completely true to say that local market selling prices are based on bulk cargo supply prices, nor is it completely true to say that bulk cargo supply prices are derived from local market selling prices. In fact these prices at two different stages of operations interact on each other. A bulk cargo supply price cannot be maintained indefinitely at a level higher than is consistent with selling prices that can be recovered on the oil when sold in local markets, nor can local selling prices be maintained indefinitely at levels inconsistent with relevant bulk supply prices. It remains fundamentally true, however, that in the long term, bulk supply prices must reflect competitive conditions at the final point of sale to consumers.

Similarly, there is a mutual relationship between bulk cargo crude oil prices and products prices. On a short term assessment it is true to say that finished products selling prices in a market supplied by local refineries from imported crude are influenced largely by the basic prices for the crude oils. But on the longer view it remains fundamentally true that prices for crude oils—the raw material of the industry—derive from prices obtained for finished products from consumers. Within the whole structure of prices from wellhead to consumer there is a mutuality of interacting relationships.

The World Products Price Pattern

The current pattern of international main products prices is essentially simple. The main *potential* source of supply is the U.S. Gulf of Mexico. It is not currently the main *actual* source of supply for world markets, as most cargoes of finished products from this source are shipped to the U.S. Eastern Seaboard. Nevertheless, with the large crude oil producing and refining capacity behind it, this market has a powerful influence on the world situation. This is a broadly based competitive market in which many buyers and many sellers participate. The day-to-day prices in the U.S. Gulf are published by several reporting services, such as Platt's Oilgram Price Service, Reuter's Trade Service, etc. The ranges of prices reported represent independent market surveys—the actual companies whose prices enter into these assessments are anonymous.

The second most important potential source of supply, and the most important actually, is the Caribbean area, where a number of companies have refineries both large and small. As this source is close to the U.S. Gulf and is placed to serve competitively the same markets, Caribbean products prices tend naturally to align themselves closely to U.S. Gulf prices. Several of the largest refineries in this area publish their cargo prices, which are regularly reported in Platt's Oilgram and other trade journals. These are the so-called "posted" cargo prices. Other suppliers who do not "post" prices, generally sell their cargoes at similar "private" prices.

The third most important source is the Persian Gulf where the number of refineries is limited, but with the establishment of the "consortium" to operate the Abadan refinery this source has become more broadly-based in respect of the number of suppliers. There are no regularly-published cargo prices for this source, and the pricing practices of the individual suppliers, as far as the author's information shows, present a somewhat mixed pattern. Supplies from Persian Gulf sources to the West of Suez markets have to be sold competitively with supplies to those markets from other sources. Supplies to the Indian Ocean area and the Far East are priced broadly in line with U.S. Gulf—Caribbean prices. For certain destinations or special customers lower prices may have to be accepted in accordance with the competition to be met.

The fourth main supply source meriting separate mention is the Far East (Indonesia—British Borneo). Finished products supplied from refineries in this area of crude oil production are strictly limited, and insufficient to meet the needs of Far Eastern markets as a whole. This source of supply is therefore tributary to the main sources, and prices there bear a natural market relationship to prices from the other main sources, taking into account geographical differences.

Two major suppliers now post cargo prices for products at Far Eastern supply points, one at deepwater and one at a shallow water loading point.

Supplies from other sources, such as the export surpluses of local refineries in Europe, have to be sold within the pricing framework created by the main source prices, and thus to suffer the disadvantage of any extra handling and freight involved.

On account of the tendency to establish refineries in countries of consumption, away from the sources of crude oil production, petroleum tends to be moved, and thus priced, in international trade, more and more in the form of crude oil and less and less in the form of finished products. However, a large ocean movement of finished products cargoes continues, and its pattern is broadly as follows: from U.S. Gulf—Caribbean—to N. and S. America, Europe, and West Africa. From Persian Gulf—to the Indian Ocean area, Far Eastern markets, and the Mediterranean. From Far East supply sources (Indonesia—Borneo)—to Far Eastern markets.

The World Crude Oil Price Pattern

Prices for the main products at different sources are readily comparable because qualities are closely standardized. But crude oil is not a homogeneous commodity: it is a generic term covering a range of qualities from virtually solid bitumen to a virtually usable motor spirit. Every crude oil from every field is different to some extent from every other crude oil, and the assessment of the relative values of two crude oils will differ for each refiner according to his equipment and desired products out-turn. Comparison of the prices of crude oils of different qualities available at the same or nearby loading ports, and still more, of prices of different crude oils available at widely separated loading ports, is therefore a matter of judgment rather than of objective assessment. The wide range of different f.o.b. cargo prices of various Venezuelan crude oils published by the half-dozen main crude oil exporters there reflects such quality differences; these relationships may of course change from time to time in accordance with market developments.

If we wish to compare say the f.o.b. U.S. Gulf price of West Texas sour crude with the f.o.b. Persian Gulf price of Arabian crude we first have to make the working assumption that these two crudes are of approximately equivalent refining value. On this basis, which is broadly reasonable, it is apparent that today, allowing for a fair long-term freight differential, plus U.S. import duty, Arabian crude is approximately competitive with W. Texas crude for delivery to the U.S. Eastern Seaboard. A similar comparison is valid for Arabian with Venezuelan light general refining crudes. For delivery to South America, where the freight disadvantage of Middle East crude is smaller, U.S. or Venezuelan crudes have difficulty in maintaining their competitive position.

Thus Middle East crudes, which currently are imported into U.S. Eastern Seaboard refineries to the tune of about 250,000 b.d., have extended their disposal area, under the pressure of their tremendous production potential, and to the accompaniment of price competition, to the virtual limit—to the native preserves of the U.S.A. itself. Hence, as already said, Middle East crudes are today about a dollar a barrel cheaper at deepwater loading port than comparable U.S. crudes, and apart from a relatively small quantity of specialized feedstocks, U.S. crudes have ceased to be shipped to the world's markets. This situation is a classic illustration of the way in which slowly, but none the less surely, the realities of supply and demand factors, in a unified world market, express themselves in the development of competitive prices.

The pattern of the world crude oil market is thus even simpler in essence than that for finished products, apart from the complication of quality comparisons, and it is important to stress once again that the international movement of crude oil is outstripping that of finished products.

The keystone of the edifice is the series of cargo prices for various types of Middle East crudes f.o.b. Persian Gulf loading ports, published by some 18 different companies (including the members of the Iran consortium). To these prices are closely linked the published prices for Middle East crudes available at Eastern Mediterranean pipeline terminals. Their higher f.o.b. prices reflect the geographical relationship between the two sources by reference to the main westward flow of Middle East oil.

The multiplicity of published prices for Venezuelan crude oils of a wide range of qualities and types is the second most prominent pricing feature on the international crude oil scene.

Other non-U.S. sources of supply of crude oils to the world market are limited in potential, and are tributary to these two main sources. Their prices therefore have to be set competitively within the main framework. In the Far East, there is as yet only one published cargo price for crude oil.

The Crude Oil-Products Price Relationship

The link between crude and products prices is the refining operation. For any given refiner the difference between:

(*a*) the ex-refinery return realized on all the products which he makes and sells, and

(*b*) the price delivered to the refinery which he pays for his crude oil

represents what is usually called the "gross refiner's margin", out of which he has to cover his costs and make a profit.

In any specific case this margin per unit of crude refined depends on various factors such as the pattern of products out-turn (which is dependent in turn on the possibilities of the refiner's equipment and available markets) and the geographical location of the refinery in relation to source of crude and markets for products. The margin for any specific refinery therefore varies with variations in these factors as well as with variations in the basic prices of individual products and crude oil. In extreme situations and at certain times the margin for some refiners may be insufficient to cover their costs and they are faced with choosing between the unpleasant alternatives of shutting down or continuing to pile up losses, in the hope of better times. This situation has from time to time arisen in the past in the U.S. Gulf of Mexico region, where smaller-scale refiners with high unit costs have shut down their plants in the face of thin refiners' margins, *i.e.*, they have been squeezed too hard between crude and products prices. In some contrary situations the prospect of a fat margin has attracted new refinery investments in certain locations such as in the Mediterranean and in the Far East, but competition between such refiners, similarly situated, then reduces the margin by the process of reducing ex-refinery prices for products. In other words, refiners' margins tend towards the bare refining costs of the least efficient refiner who stays in business—the "marginal refiner". Any refiner must accept the risks of the fluctuations in his margin between crude oil prices and finished products prices, each being determined by the play of the competitive market. If he is operating as an independent refiner, selling his products, he cannot secure his margin by a "cost plus" computation of products prices—indeed there is no generally acceptable objective method of thus calculating prices for individual refinery products, which are joint products from a single manufacturing process.

The North West Europe Price Equation

Before the second world war, and in the immediate post-war years, North West Europe received petroleum supplies mainly in the form of finished products cargoes shipped from the main world supply sources—the U.S. Gulf, the Caribbean, and the Persian Gulf. A substantial, but still minor, proportion of supplies to this concentrated area of consumption was provided by the local refining of crude oil imported from both the Middle East and the Western Hemisphere—France and Holland were examples of N.W. European countries where there was already a degree of local refining. In these conditions the prices of products in N.W. Europe, regardless of their actual origin, were very closely related to the import price of supplies from the U.S. Gulf—Caribbean area. This basis of prices was generally regarded as logical without further question. In the U.K. for instance, any freelance enterpriser could buy a cargo of gasoline in the U.S. Gulf market, charter tanker tonnage, hire Thames-side storage, and distribute the product to resellers in the London area—and many did. This competitive price level thus set the pace for other marketers, major or minor, obtaining their supplies by different routes.

Today the predominant method of supply to N.W. Europe is by the local refining of crude oil imported from the Middle East, although substantial supplies still come in as finished products imports—notably fuel oil from the Caribbean. In these conditions the question is often posed: "Why should the prices of products in Europe continue to be based on U.S. Gulf prices, when most of the oil comes actually from the Middle East?"

First, it can be assumed that the question really relates to N.W. Europe. In the Mediterranean, and notably in Italy, local refinery supplies, as the result of competition between the many local refiners, obtain prices diverging considerably from U.S. Gulf or Caribbean import parity and generally lower. Here, the trend towards reduction of the refiner's margin to the cost of the "marginal refiner", based on supplies of Middle East crude, has proceeded far. North West European refiners however, are much less advantageously situated in relation to Middle East crude supplies, and the factors entering into their refining margin bear a different relationship.

Even in respect of N.W. Europe however, there is only the most tenuous thread of truth in the assertion that prices of products are "based on U.S. Gulf prices". For the last decade the level of import parity has been set by reference not to the U.S. Gulf but to the Caribbean. Generally speaking, products prices f.o.b. Caribbean refineries, are level with the *lowest* f.o.b. U.S. Gulf prices, and Caribbean ports have a freight advantage of several shillings a ton over U.S. Gulf ports, so that the competitive "import parity" for N.W. Europe already for many years has been at a lower level than import parity "based on U.S. Gulf".

The question remains, however, in its re-stated form: "Why should prices of products in N.W. Europe continue to be based on Caribbean supply prices?"

It is not precisely or generally true that they are "based on Caribbean supply prices" in the rigid manner which the question implies. The local supply pressures for various products manufactured by N.W. European refiners, expressed in the competition among them for outlet, have modified in some respects any clear relationship between selling prices in N.W. Europe and basic cargo prices in the Caribbean. Selling prices for fuel oil, which is in strong demand in N.W. Europe, and calls for substantial imports from the Western Hemisphere, are fairly clearly sustained at Caribbean import parity. Primary light distillates, such as low octane gasoline, on the other hand, tend to excess production from local refineries in relation to demand, and their prices for local disposal as against the alternative of shipping them away to distant markets or applying expensive upgrading processes, thus tend to be set below Caribbean import parity. For instance, the price differential at the pump between Premium and Ordinary grade motor gasolines in the U.K. is 6*d*. or 7*d*. per Imperial Gallon, whereas the Caribbean cargo price differential for corresponding grades is only about 2.3*d*. Even allowing for a reseller's margin higher by 0.75*d*. on Premium grade, and perhaps some higher distribution costs, it must be obvious that the ex-U.K. refinery returns accepted for the two grades bear a substantially different relationship from that indicated by Caribbean import parity.

It is nevertheless true that "Caribbean import parity" constitutes a factor in the N.W. European refiners' price equation. In most of the N.W. European markets the threat of potential competition from Western Hemisphere imports sets a ceiling to the price obtainable from any product by a N.W. European refiner operating on Middle East crude. On the other hand, the operation of buying crude from the Middle East and freighting it to N.W. Europe leaves only comparatively small scope for even an efficient refiner to accept on any product for a sustained period a price very substantially below the "Caribbean import parity" ceiling: there is no scope for this on all his products.

As long as petroleum is free to move both as crude from the Middle East (or elsewhere) and as refined products from the Western Hemisphere (or elsewhere) to N.W. Europe, selling prices of products in this consuming area are economically bound to bear a family resemblance to Caribbean import parity, modified for some products by the influence of local refinery surpluses. Unless an "iron curtain" is erected in mid-Atlantic, Western Hemisphere products prices cannot be excluded from the N.W. European price equation.

Crude Oil Prices and Production Costs

A question often posed is: "Why is Middle East crude priced on the basis of U.S. crude prices when the production costs are so much lower?"

From what has been said, it is clear that Middle East crude at source is in fact sold substantially cheaper than U.S. crudes at source, reflecting the geographical reality of the location of Middle East production sources in relation to the markets where it competes with Western Hemisphere crudes.

The question then may arise, "why is Middle East crude not even cheaper, since the production costs must be very much lower than in the U.S.A.?"

The idea that "production costs" of Middle East crude are absurdly low, and that therefore the crude can and should be priced by reference to such low costs plus some notion of a "fair and reasonable" profit, proves on even slight analysis to be unrealistic. "Production cost", in the sense of the current lifting cost of bringing to the surface oil from a discovered and proven underground reservoir (which is what most superficial commentators have in mind) is, of course, but a small item in any evaluation of total production cost to a risk-bearing oil-producing company. There have also to be taken into account exploration costs (both in the proven field and in areas which have yielded no return), the ancillary costs of establishing and maintaining communities

for staff and workers in desert areas, the costs of bringing the oil to a deepwater loading point, and the tax payments to the "host" governments on the generally established 50:50 basis. Over and above these tangible items, provision has to be made, out of the revenues after tax, for depletion of the underground reserves, to provide funds for the search for new oil resources to assume the continuity of future supplies. (In the U.S.A. this feature is taken care of by a tax-free "depletion allowance".)

When these factors are taken into account, and recognition is given to the political risks inherent in Middle East oil operations, the idea must be abandoned that total production costs are very low in relation to the f.o.b. posted prices of the order of $1.75 to $2.00 per barrel (the equivalent of 4½*d.* to 5*d.* per gallon). To attempt to say what is the "right" f.o.b. price of a particular Middle East crude on the basis of cost plus a "fair and reasonable" profit figure, after reducing all the tangible and intangible features of the operation to cents per barrel of current production, is even more of a poser than trying to answer one of those fantastic arithmetical problems ending with "what was the name of the engine driver?"

For an individual producer of a crude oil from a particular source, there is no reasonable alternative in free market conditions to selling his oil at a price which will secure an adequate rate of offtake, in relation to existing prices for other competing crude oils which have become established by market forces. Over the long run, differences in production costs (as subjectively assessed by the various producers) will have their influence on price levels and on the disposal of competing crude oils. But for a particular crude oil at a particular moment in time the only criterion for setting the price is the competitive market value.

The Development of Posted Prices

An important development over the last few years to which reference has already been made has been the spread of the practice by the main cargo suppliers of regularly publishing or "posting" their f.o.b. cargo prices of crude oils and refined products applying to their various supply points. These are essentially seller's quotations for spot cargo lots and generally form the basis of transactions with both affiliated and non-affiliated companies. (These "posted" prices for cargoes f.o.b. main world supply points are not of exactly the same nature as the internal U.S. field posted prices for crude oils. The latter are buyers' prices offered to producers for crude oil for delivery in the fields, not at deepwater shipping points.)

The transition from private to public pricing of international oil shipments is a development of the last decade. Currently, each of the main suppliers of crude oils from Venezuela publishes a schedule of prices for its various available types, and the same may be said about suppliers of Middle East crudes from both the Persian Gulf and the Eastern Mediterranean. There is a comprehensive range of posted prices for products shipped from Venezuela and other Caribbean supply points by the main suppliers. In the Far East two suppliers have recently introduced a range of published products quotations. There is as mentioned one representative crude oil posting for export from Sarawak.

There is little doubt that these posted cargo prices have come to stay, and that their scope will be extended. They are evidence of the recognition by the major companies that Government officials and the informed public in both exporting and importing countries are taking a progressively closer interest in the basic international pricing of oil, and that the companies for their part serve their own purposes better by "putting their tickets in the shop window" rather than by clothing their basic supply pricing in mystery. Each supplier concerned, of course, has to set its own posted cargo prices according to its own market judgment in the light of relevant competitors' prices. Posted prices are revised from time to time to reflect significant market movements as appraised by each company. If one company changes any of its more important posted prices, each of its competitors naturally has to reconsider its own postings, and it is often only after a series of competitive price adjustments and readjustments that the market settles down to a new level. Posted prices cannot be set and moved by any automatic formula.

These posted cargo prices at main world supply points now form the basic design of the international oil price pattern, and the fact that they are independently and openly set by individual suppliers in accordance with their own assessments of the market situation provides the best guarantee that there is in fact realistic competitive market pricing in the sphere of international oil supplies.

Discussion

P. M. de Veulle: One of the difficulties in dealing with the question of prices, is, of course, the composite character of the industry. It is not always apparent to the consumer of gasoline, for example, why his price should change because of something that has happened in the fuel oil market. There is a need to explain very clearly the relationship between the prices of the various products.

Mr Pattman stressed that there was no rigidity in the pricing of petroleum products. Does he foresee substantial changes in view of rising coal prices and, therefore, the ability to command a higher price for fuel oil? Moreover, because there is going to be a higher demand for fuel oil and therefore a larger proportion of this relatively cheap product in relation to gasoline required to meet it, does he also foresee a change in the gasoline price level, and if so, in which direction?

We are experiencing a great advance in the size of tankers. This is a factor which may alter routes of supply and the density of traffic on some routes, both for crude oil and for finished products. Perhaps Mr Pattman would like to comment on this aspect.

In regard to the movement of oil from the Persian Gulf to the United States, would not much of this rest on the comparative out-of-pocket expenses of the major producers in one area compared with those in another?

R. A. R. Pattman: Mr de Veulle has raised several questions. The first one was the possible future trend of fuel oil prices in view of rising coal costs and an increasing demand for fuel oil. I am not sure whether Mr de Veulle has in mind purely the situation in the U.K., because I have been looking at things very much from a world-wide point of view. I can comment on that by asking him to think of a triangular situation, created by North West Europe, the Caribbean area as a supply point, and the Eastern Seaboard of the United States as another consuming point. On the United States Eastern Seaboard with the increase in fuel oil prices in the Caribbean, some consumers are turning back from oil to coal—the marginal consumers. So we have a triangular relationship; the pull of demand from North West Europe, a common supply point in the Caribbean, and a limit to the price which the consumer will stand in the Eastern states of

the U.S.A. I think that the result of that triangle of forces is bound to be some further upward trend in the price of fuel oil in the Caribbean, and some upward trend in prices in the U.K. If Mr de Veulle is thinking of the United States Eastern Seaboard, some upward trend is to be expected there, with some turnover of the marginal consumers to the alternative fuels, such as coal and natural gas, which are keenly competitive with fuel oil in that area.

The second question raised was the influence of the increasing size of tankers on routes of supply. There is a mutuality of relationship here. The modification of routes of supply has an influence on the size of tankers that can be used, and reciprocally the size of tankers built has some modifying influence on the routes of supply. The fact that tanker transportation is becoming more efficient for selected routes, by reason of the employment of super-tankers, is one of the factors which takes some of the edge off the disadvantage of refining in local refineries away from source, and the increasing use of super-tankers is really part and parcel of this trend towards the refining of crude oil in countries of consumption.

Mr de Veulle's last point raised the question of marginal costs when you are seeking to expand your business at the competitive fringe. As Mr de Veulle knows, that is going on all the time between the companies; there is nibbling away at the fringe of competition, to win that extra customer, and to do that companies often concede prices which are lower than normal prices, which they would be willing to accept on the whole of their business, and of course, a criterion for what they can accept in those marginal cases is their out-of-pocket, or "marginal" costs. To my certain knowledge, being in an oil company, a good deal of that does go on, which merely shows that we do live in a competitive world.

M. E. Weinstein: Would Mr Pattman care to give us his opinion on the apparent lack of available information about basic oil prices in the U.K. Press. He said that prices are widely published and he also reminded us that oil is today the greatest commodity in international trade. In the U.K, which almost invented international trade, one would expect to find a service of published prices in the more informative Press. In fact, outside such learned journals as the one Mr de Veulle is connected with, and I think only one other, there is no service for published prices for oil, the greatest of international commodities, whereas every other commodity has its prices published daily in *The Times*, *The Financial Times*, and so on. Why should that be?

Mr Pattman: There are rather different characteristics in the trade in oil, from the trade in other international commodities, and different characteristics in the pricing. For instance, if we might take copper, for which the daily auction market is in London, it is rather natural that one would see those prices in the appropriate column of the paper which Mr Weinstein reads, but not necessarily in the paper which everybody coming up on the Tube reads. The basic pattern of international oil pricing consists of the basic cargo prices in the supplying countries, where they are often published in the Press, because the country of supply takes a keen interest in them.

As far as the companies are concerned, I can speak only for my own Company, but we are very happy to inform anybody who is interested, at any time, all about our prices. I feel that the Press publishes what it thinks is most interesting to its readers, and in that connexion, I notice that *The Financial Times*, over the last few years, has taken a progressively greater interest in oil matters and when there are any changes in basic prices, they certainly have something to say about it, and I think that is all to the good.

A. L. King: Mr Pattman said that the tendency to post prices is almost certain to increase and extend in various directions, which I suppose will make it far more likely, in fact, that the National Press will deem them to be of interest and importance to the general public.

Mr Pattman: There is a possibility that the more reputable papers may well, at some later stage, be prepared to give a few inches of space to it, and I am sure that any of the oil companies concerned would be only too pleased to help them.

J. Clarke: It was very right of Mr Pattman to emphasize the fact that the Caribbean parity prices tend to impose a ceiling on prices in the U.K. I do not think it is appreciated by those outside the industry that that is, in fact, the case, and that when a rise takes place in the world price of the product, in the U.K. or generally, one has to reflect that increase in order to supplement the extremely fine refining and marketing margins which are in force in the market today.

We had a similar type of movement a few months ago, when the coal price on the Continent rose to match the landed price of American coal, so that they adopted what you might call a U.S.A. parity price on the Continent; and one can perhaps envisage in the future, even in the U.K., as the area is becoming a net importer, the price of coal rising to a level that will match the U.S.A. parity price of coal.

I mention that because it seems to me that oil is not an isolated commodity and its pricing is not dissimilar, in fact, to that of other commodities in the world market.

Mr Pattman: I am very interested to hear the observation, with which I thoroughly agree. I can perhaps only add that it might have been a good thing for the coal industry if they had adopted marginal parity prices a long time ago.

Mr Thackeray: I happen to have read in the last two or three days that a new survey published by the Chase Manhattan Bank makes a forecast of United States demand, production, and imports, for 1956, and comes out with a figure for imports of three million barrels a day, or nearly three times the present rate. I do not remember off-hand what the figure in respect of the Middle East was, but clearly a good part of it seems to come from there, and I think it is a rather interesting commentary from somebody who has studied these matters for many years.

With reference to a point raised by Mr de Veulle, which Mr Pattman answered, about the relationship between oil prices and oil costs, and the question of whether the out-of-pocket expenses are really the factor which very often determines an oil movement, might not the question be slightly different when the oil movement is carried out by the same concern, which is going to refine the crude when it gets to its destination? I raise this point, because I have in mind the situation on the United States West coast, which is a highly competitive area.

(*concluded on page* 146)

IP Council and Officers 1956-7

At the Annual General Meeting of the Institute on 25 April 1956, the nomination of the Rt. Hon. Lord Geddes as President for the session 1956-7 was unanimously approved.

Lord Geddes has had a distinguished career in the oil and tanker industries both at home and abroad.

On leaving Cambridge, he joined Silica Gel Ltd and worked at the Company's head office in Baltimore on the various applications of silica gel, including its application for the refining of motor benzol.

In 1931 Lord Geddes joined Shell and gained a variety of experience at the Shell refinery at Martinez, California, in the manufacturing department at San Francisco, and in the Petroleum Exploitation Engineering Department and the Production Department at Los Angeles. He was then transferred to Shell Eastern Petroleum Products Inc. where he worked at the President's office of that Company in New York, and later took charge of manufacturing estimates for the West Coast Company.

Lord Geddes

In 1934, Lord Geddes took up the position of operations manager of Shell Oil Company of Canada Ltd, a position which he held until 1937 when he returned to London to assume general responsibility for fuel oil supplies in the Fuel Oil General Department of the Asiatic Petroleum Company.

On the outbreak of the second world war Lord Geddes took on the task of setting up the Oil Bunker Liaison office, with responsibility for the co-ordination, and in some cases the planning, of bunker fuel supplies to overseas depots. In 1940, however, he was transferred to the Tanker Division of the Ministry of Shipping where he remained, as assistant director, until 1942, when he went to Washington as the Tanker Member of the British Merchant Shipping Mission. In 1944 he returned as deputy director of the Tanker Division.

Shortly after the end of the war, Lord Geddes resigned from the Shell Group to become a partner in Chr. Salvesen and Company, Scottish whaler and tanker owners, and in 1950 he formed his own tanker business which he now conducts from Edinburgh. Lord Geddes also acts as tanker adviser to the P & O Group of Companies, a task which he took up in 1955.

Lord Geddes is Chairman of the Admiralty Fuels and Lubricants Advisory Committee.

Vice-Presidents

At the same meeting E. Le Q. Herbert, B.Sc., F.R.I.C., M.I.Mech.E., and R. B. Southall, C.B.E., were elected as vice-presidents in place of J. A. Oriel, C.B.E., M.C., M.A., B.Sc., F.R.I.C., M.I.Chem.E., who has resigned from this position owing to pressure of work, and G. H. Thornley, M.Sc., who has retired on completion of his three-year term of office.

E. Le Q. Herbert

Mr E. Le Q. Herbert has been a Fellow of the Institute since 1935 and a Member of Council since 1950. He serves on the House committee.

Mr Herbert is managing director of "Shell" Refining and Marketing Co Ltd, and executive director manufacturing of Shell Chemical Co Ltd. He has had some twenty-nine years' service with Shell, having served for twelve years in Mexico—at Tampico, Minatitlan, and Mexico City; subsequently, on his return to this country, he was for a time at Shell Haven. He was transferred to the Head Office of "Shell" Refining and Marketing Company in London early in 1939 as assistant to the then general manager, J. A. Oriel, and was subsequently appointed assistant general manager, general manager in 1952, and managing director in 1955.

Mr Herbert is a graduate of Edinburgh University, a Fellow of the Royal Institute of Chemistry, Member of the Institution of Chemical Engineers, and Member of the Institute of Fuel. He has served on the Council of the Institution of Chemical Engineers for the past three years and is a member of Council of the Association of British Chemical Manufacturers.

R. B. Southall, who was previously vice-president from 1952 to 1955, has been a member of the Institute since 1925 and a Member of Council since 1946. He was chairman of the South Wales Branch from 1944 to 1948 and is now Chairman of the Public Relations Committee. He also serves on Branches, Election, Engineering, and Finance committees.

R. B. Southall

Mr Southall has been a director of National Oil Refineries Ltd since 1950, a company which he first joined in 1921. In 1936 he was appointed assistant refinery superintendent, becoming refinery superintendent in the following year. He was made works manager in 1941 and general manager in 1943.

Mr Southall is one of the United Kingdom delegates to the meetings of the ILO Petroleum Committee.

M. E. Hubbard

Council

The one vacancy on Council was filled by the election of M. E. Hubbard, B.A., M.I. Mech.E., who joined the Institute in 1927, becoming a member in 1934 and a Fellow in 1939. He has been on the Committee of the Economics and Operations Group of the Institute since its formation.

Mr Hubbard is on the staff of the British Petroleum Company Ltd and is at present engaged on special duties mainly in connexion with the international problem of oil in relation to the general energy position. He first joined the Company in 1924 as a junior engineer and from 1926 to 1939 was concerned with refinery construction for an associated company in France. He was largely responsible for the building of the Lavera refinery near Marseilles.

On returning to London he was appointed a senior engineer in Refineries Department and, during the earlier part of the war, was seconded for a time to the Government in connexion with the development of flame throwers.

In 1943 he was appointed assistant manager, under G. H. Coxon, of Central Planning Department, and became more concerned with petroleum economics. He was subsequently appointed deputy general manager, Supply and Development, before taking up his present special duties.

Ex-Officio

The following were elected as *ex-officio* Members of Council: S. A. Berridge, A. S. Brooman, G. M. Davies, P. F. Ellis, J. C. Jewell, and W. M. Stirling.

Honorary Officers

G. H. Coxon (Anglo-Iranian Oil Co Ltd) was unanimously re-elected as Honorary Treasurer, and C. Chilvers (Esso Petroleum Co Ltd) as Honorary Secretary.

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Birmingham Students' Dinner

Guest of honour at the Ninth Annual Dinner of the University of Birmingham Chemical Engineering Society and the Student Section of the IP, held on 6 March, was Dr H. K. Cameron, deputy-director of Research, The General Electric Company. Representatives of the petroleum industry who were present were B. G. Banks (Trinidad Leaseholds Ltd), Dr E. T. Borrows (Petrochemicals Ltd), J. S. Parker (Lobitos Oilfields Ltd), Dr A. W. Pearce (Esso Petroleum Co Ltd), C. A. P. Southwell, C.B.E., M.C. (Kuwait Oil Co Ltd), and G. Sell (Institute of Petroleum).

The Chemical Engineer and the Electrical Industry

The dinner was presided over by J. C. Yeoman, chairman of the Society. The toast of the evening was "The Chemical Engineer and the Electrical Industry" and proposing this, Professor F. H. Garner, O.B.E. (Professor of Chemical Engineering), said that their Chemical Engineering Department had expanded more than ten-fold in the last ten years and research students had risen from none in 1942 to about seventy now. This justified their new building, but presented many problems both in organization and in teaching. They were hoping to have an increase in the teaching staff in order to extend the tutorial system so that individual contact could be maintained between the students and the teaching staff. The course of study was continuously subject to modification and under continuous discussion by the teaching staff. The only organization worthwhile was a live one.

Much nonsense was being talked about the cream of the universities being required by industry, or in another connexion, that only 80 first-class brains were being produced by the whole of the universities in one year, continued Professor Garner. If they looked at a milk bottle they would see a sharp dividing line between cream and milk. There was no sharp dividing line in intelligence, except at the very top. A Newton or an Einstein might be produced once in a century or so, but with mortals on a lower level there is not a dividing line but a zone, and the 80 might easily be 100 or possibly 120 if adequate care had been taken in education at all stages of life to develop individuals to their maximum capacity.

Our educational system was still geared to that required at the end of the 19th Century when large numbers of officials were required for colonial administration. We needed to return to an earlier period in the 19th Century when technologists such as Parsons developed their own industry.

The Chairman of the Society, J. C. Yeoman, presenting Professor Frank Morton with a gift from the Society.

Professor F. Morton and Dr T. K. Ross, as they knew, were to leave Birmingham shortly to take up posts in the Chemical Engineering Department in Manchester University. Professor Garner said he was sure that all would join him in

wishing them every success. This was the first occasion on which they had had as their principal guest a representative of the electrical industry. They were pleased to welcome Dr Cameron, who was typical as a technologist in that he had a wide interest in non-technological subjects.

The Guest of Honour

Dr H. K. Cameron (deputy to the director of research, The General Electric Co Ltd) replying to the toast of "The Chemical Engineer and the Electrical Industry", said that although his own company was concerned with electrical engineering many of the problems to be faced in the industry would not be strange to the chemical engineer. Posing the question of the role of the chemical engineer in the electrical industry, he had to admit that not many were at present employed by his Company. He was himself proud of his membership of the Institution and hoped to see a closer relation between the profession and the electrical industry in the future. Much turned on definition. It had been suggested that the chemical engineer was an applied physicist and by this definition the chemical engineer would find much to interest him in the supply and utilization of electricity. He said that his own Company, for example, had a large research laboratory and two of the three divisions were called "Chemistry and Engineering" and "Physics and Applied Physics".

Dr Cameron then gave some examples of problems faced by the electrical industry; on the supply side, the more efficient cooling required for the ever-larger alternators necessary to modern practice, and the design of nuclear power reactors; while there were many others, such as the manufacture of light sources, concerned with the utilization of electricity. He left it to his audience to judge whether these problems were such that they would regard them as within their own sphere of knowledge and interest.

In conclusion, Dr Cameron thanked them for the enthusiasm with which the toast had been received.

The Guests

R. G. Brewster, junior treasurer of the Society, proposed the health of the guests in an entertaining speech and pointed out that they included representatives of the industries to whom the students were much indebted. The technical societies associated with the Department were also represented —the Institute of Petroleum and the Institution of Chemical Engineers.

(Left to right) *Dr E. H. T. Hoblyn* (BCPMA), *R. S. Law* (Whiffens Ltd), *Dr S. R. M. Ellis* (Chemical Engineering Dept), *W. E. Aylwin* (Midland Tar Distillers Ltd), *A. H. Loveless* (Albright & Wilson Ltd), *and H. A. Anderson* (Albright & Wilson Ltd).

Dr A. W. Pearce of Esso Petroleum Company, himself a graduate of the Department, speaking on behalf of the guests thanked the Society for its hospitality and recalled his own days in the Department.

Proposing the toast of the Society, Dr Pearce said that companies were turning more and more to the chemical engineers to provide management personnel. Britain could not afford to have qualified chemists and chemical engineers engaged on routine tasks. They must be selected and trained to fit into their proper place and their opportunities were great.

The chairman of the Society thanked the assembly for the enthusiasm with which the toast had been received. He referred to the activities of the Society during the last year in various fields of endeavour. It had been a successful year and they were grateful to Professors Garner and Morton for their encouragement and support. They were sorry that they were to lose Professor Morton and they asked him to accept a small gift as a token of their thanks for his interest in their affairs.

At the Birmingham Students' Dinner

(Left) *The guest of honour, Dr H. K. Cameron, with Professor Frank Morton* (l) *and Professor F. H. Garner* (r). (Centre) *D. C. Freshwater, Dr A. W. Pearce, and Dr R. Long.* (Right) *J. S. Parker* (r) *tells Gordon Jarmain* (l) *and Gordon J. Harris some of the advantages of the petroleum industry.*

Around the Branches

BAHRAIN, FAWLEY, KUWAIT, LONDON, NORTHERN, SCOTTISH, SOUTH-EASTERN, SOUTH WALES, STANLOW, TRINIDAD

London Branch

The annual general meeting of the Branch was held on 29 February with W. H. Davies in the chair. The Chairman reviewed the activities of the Branch over the past twelve months, and commented on the progressive and continuing increase in membership.

Following the annual general meeting a paper entitled "Oil Refining in the United Kingdom" was presented by W. Kohring.

After briefly tracing the expansion of refinery throughput in the U.K. from about 3 million tons in 1938 to about 30 million tons per annum at the present day, Mr Kohring dealt with the requirements to be considered in selecting a refinery site and followed this by describing the layout of a modern refinery. Mr Kohring then went on to describe the refinery process and the operation of a Thermofor Catalytic Cracking unit for the production of high-octane, anti-knock gasoline. The various lubricating oil processing units were described and mention was made of the general layout of the propane deasphalting unit, the furfural unit, the M.E.K. unit, and the filter house, showing how correct siting ensures an even flow of production.

The power plant was then considered and Mr Kohring described the methods used in firing the various furnaces using refinery gas. Maintenance problems were described, such as the necessity to plan several months ahead of shut-down for overhaul of the catalytic cracking unit, which takes about 3 weeks and entails 20-30,000 man-hours of work.

When describing the various types of corrosion problems encountered in a refinery Mr Kohring described some of the methods used in combating them, including the injection into the hydrocarbon stream of "film formers". These form a protective film over the metallic surface and are used in minute quantities by continuous injection.

The speaker then described some of the problems encountered at a tidal jetty caused by a combination of a large tidal range and the difference in elevation between empty and full tankers.

After some remarks on safety and fire protection Mr Kohring concluded his paper with some observations on the civil aspect and the need for disaster planning, instancing the floods on the East Coast of England in February 1953.

Scottish Branch

A meeting was held at Grangemouth on 30 March at which J. M. Caldwell, J.P., presided, and A. T. Wright gave a talk on "Insurance in the Oil Industry".

After outlining the objects and history of insurance Mr Wright said that the development of the oil industry had affected almost every branch of insurance; marine insurance by the increasing number and size of tankers and the use of oil as fuel, and general insurance by the development of motor vehicles, aircraft, and oil-driven machinery in industry and agriculture. The oil industry had introduced a variety of new hazards from the insurance point of view and it had become necessary to devise appropriate protective measures. On the other hand the use of oil as a source of energy had contributed very largely to the high standard of modern fire-fighting methods, not only within the industry but also elsewhere, for example by enabling fire-fighting appliances to be brought to the scene of a fire in a fraction of the time previously taken.

The system of insurance had assisted to a large degree in the development and operation of modern industry, and, in a like measure, industrial development had stimulated a demand for insurance.

Members of the IP Branches Committee who, during the Stanlow meeting, were entertained to lunch by Lobitos Oilfields Ltd, seen outside the Company's guest house at Fiddlestone Wood.

IP Branches Committee members being shown around Stanlow refinery. The ladies were taken round in a separate party and—

—in the afternoon, while the Branches Committee meeting was in progress, visited the ancient city of Chester.

It was remarked that in the oil industry more than in any other sphere of modern industry, large capital investment was the key to growth and development. Without insurance, and the security it provides, private capital would not have been risked to any appreciable extent.

An outline of the basic insurance needs of the oil industry was then given; fire and explosion insurance on shore assets and stocks; motor transport insurance to cover loss or damage to the vehicle and liabilities to third parties; employers' liability insurance in respect of industrial accidents to employees; public liability insurance (liabilities to third parties arising out of a company's operations); engineering insurance; marine insurance on purchase of plant and equipment from source of supply to site; marine insurance on vessels, including shipowners' liabilities (liabilities for damage done to other vessels and to fixed objects, personal injury, and crew liabilities, and carriers' liabilities towards cargo owners); marine insurance on cargoes in transit by sea or by inland waterways.

After describing in some detail each aspect of insurance Mr Wright turned to the importance of insurance as a sphere of operation within the orbit of company management. In this connexion he said that in the larger undertakings it was not unusual to look upon insurance as a specialized field demanding the services of a full-time insurance executive, heading a separate department, who assumed full responsibility for maintaining an up-to-date record of insurable values of assets, considering the risks to which those assets were subjected and the liabilities, undertaking an analysis of those risks, developing the insurance programme best suited to the risks involved in relation to the resources of the company, and negotiating the required insurance contracts.

Reference was also made to the system of self-insurance, which is adopted by some of the larger undertakings for selected risks.

In conclusion the speaker pointed out that insurance was a means of securing financial protection, but prevention was as important as protection for there was a definite relationship between the cost of insurance and losses. Oil as a commodity was in itself dangerous unless it was handled in accordance with generally accepted safety standards, and there was due observance of those standards by employer and employee—more often than not losses were attributable to the human element. Although insurance was a means of providing reimbursement of financial loss as the result of fire or other casualty, any loss, however caused, whether recoverable by insurance or not, was a form of wastage. Only by constant watch over the company's loss experience by the insurance executive could such wastage be kept to a minimum, with resultant benefit to the company's financial structure.

Chairman's table at the Stanlow Branch Dinner-Dance. (Left to right) *Mrs G. M. Davies, Alderman Flather, Mrs G. H. Thornley, V. Biske, Mrs Flather, G. H. Thornley.*

V. Biske, chairman of the Stanlow Branch, and Mrs Biske (right) *with their guests of honour, Alderman and Mrs Flather.*

At the Stanlow Dinner-Dance. Refinery managers (left) *C. R. Middleton and* (right) *J. S. Parker with the Mayor of Ellesmere Port.*

South Wales Branch

On 5 January the South Wales Branch held a very well-attended meeting to hear Professor E. S. Sellars, of Swansea University, speak on the subject of the education, training, and future of chemical engineers. This talk proved to be of considerable interest to the members and a useful discussion followed. At the close of the meeting a vote of thanks proposed by Dr Islwyn Jones of Neath Technical College was heartily applauded.

On 1 March, J. G. Withers spoke to the Branch on the development of high performance lubricating oils. He first described the properties demanded of modern automotive oils. Besides lubricating, they had to prevent the formation of carbon, lacquer, and sludge deposits, remain stable under extreme conditions of temperature, prevent wear, provide easy starting, and give low fuel and oil consumption.

In recent years there has been a trend to the use of lower viscosity motor oils, but viscosity cannot be reduced beyond a certain limit without the risk of inadequate lubrication. The ideal lubricant should have a sufficient viscosity at the running temperature to provide adequate lubrication, and a viscosity for winter conditions and a higher one for summer. Modern all-season high performance motor oil eliminated the necessity for seasonal changes.

Mr Withers went on to describe the laboratory and field work involved in the development of an all-season oil and said that experience had shown that the greatest engine wear occurs in short stop-start journeys. He quoted data demonstrating the cumulative effect of eliminating start-up wear and reducing it at steady running conditions to a low level.

After dealing with the factors affecting engine cleanliness Mr Withers discussed high temperature and low temperature corrosion.

A lively discussion followed and a vote of thanks was given by E. J. Jones.

Stanlow Branch

The Annual Dinner and Dance on 23 March was, as usual, a successful and enjoyable function, and was attended by over eighty people, including the Mayor and Mayoress of the Borough of Ellesmere Port and members of the IP Branches Committee and their ladies. The venue was Thornton Research Centre.

V. Biske, chairman of the Branch, in welcoming the Branches Committee, said that that Committee, like the judges, went on circuit and visited the provinces to see for themselves how things were going. He extended a special welcome to Alderman and Mrs Flather, the first Mayor and Mayoress of the newly-created Borough of Ellesmere Port. The Borough, of which Stanlow was a part, had a long association with oil and in the 'eighties of last century had a Diamond and a Crystal oil company. Today it had a close link with the Institute in that the IP crest, the *archaeopteryx*, which was fairly recently re-born on the walls of a local petroleum research laboratory, had migrated to Ellesmere Port and had come to roost in the mayoral chain.

They were also pleased to have with them the IP Editor, George Sell, together with Mrs Sell, and no doubt the *IP Review* would in due course show the results of his presence. In conclusion, Mr Biske expressed the thanks of the Branch to the "Shell" Refining & Marketing Co Ltd for making their premises available for the function and to those members of their staff who had helped with the arrangements.

George Thornley, chairman of the IP Branches Committee, expressed the thanks of the Committee members and their ladies for the hospitality shown by the Stanlow Branch. The Mayor of Ellesmere Port also expressed the thanks of the Mayoress and himself.

Dancing commenced immediately after dinner and continued until midnight.

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Council Commentary

At the Council meeting which was held on 14 March, it was unanimously agreed that Mr H. Hyams should be awarded the Eastlake Medal in recognition of the long and meritorious service which he had given to the Institute. The presentation will coincide with the Autumn Council Dinner in October of this year.

Much lively discussion took place on IP Standard Methods for Testing Petroleum and its Products with particular respect to co-operation with ASTM. Mr Garton reported that by virtue of correspondence between the Chairman of Sub-Committee and Panels and their opposite numbers in ASTM, considerable progress had been made towards limiting differences between ASTM and IP methods.

A valuable suggestion was that a closer working agreement with continental countries would be an advantageous starting point towards further progress in obtaining agreement with ATSM on methods which were not, at the present time, technically equivalent. To this end the President suggested that as a first step, two meetings should be held; the first to discuss the matter with the BSI and the second to convene a European Conference on international standardization.

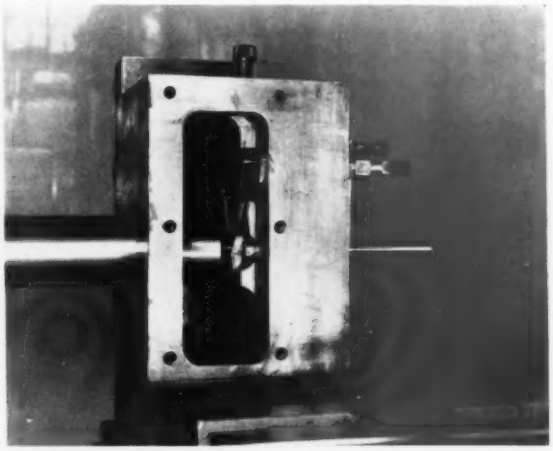
It was reported that the draft of the Aviation Fuels data sheets have now been finalized together with the Lubricating Oil data sheets. Both sets of sheets will be published by the Royal Aeronautical Society.

Testing of Cutting Oils and Tools

In the metal-working industries an important factor in production costs is the effective life of cutting tools. A long tool life means not only that the ratio of production time to idle time is greater, with consequent reduction in tool and labour costs, but also that the life of the cutting fluid is increased and its chance of contamination reduced.

To fully test cutting tools and coolants has hitherto necessitated high costs in equipment and personnel and a long period of time. For example, to establish that one soluble cutting oil gave 4 per cent greater tool life than another, required two expensive machines working for three months and producing two thousand components each.

Recently, at the Hammersmith works of Alexander Duckham & Co Ltd there was demonstrated a method whereby cutting coolants and cutting tools could be adequately tested within a few hours.



Interior of the cooling chamber showing the two coolant jets.

The principle of the method, the first of its kind in Great Britain, is the use of a radio-active cutting tool so that, as the tool wears, radio-activity is transferred to the turnings and the coolant. By measuring the radio-activity so transferred, the wear on the tool can be assessed.

Cutting Tool

For the cutting tool it was necessary to have a material, the radio-active isotope of which would have a sufficient half life and energy for studies over a reasonable time. For the experimental work Wimmet X.8 tungsten carbide was selected, its composition being:

Tungsten carbide . .	77%
Cobalt	8%
Titanium carbide . .	15%

This material, after neutron bombardment in a nuclear reactor for about one week, gave isotopes of cobalt 60 and tungsten 185. These have the following half life and radiation characteristics:

	Half life	*Radiation*
Cobalt 60. .	5.2 years	Beta and Gamma
Tungsten 185 .	73 days	Beta

The tungsten-carbide tipped tools are irradiated at Harwell to a total beta-gamma activity of about 15 millicuries per gram of tip, the approximate proportions being 10 mc beta and 5 mc gamma. For tool wear studies, only the gamma radiations are used as they have better penetration and recording properties than the beta radiations.

An activated cutting tool gives some 80 minutes of cutting time per tool edge. As cutting tests of six to ten seconds duration are adequate, some 500 tests can be run once the machine has been set up.

Test Method

As 95 per cent of tool wear products are found in the chips, the test consists of measuring the radio-activity of the latter.

The work piece is tubular steel of 60 ton tensile chrome molybdenum in the annealed state. The cut is taken at right angles to the circular axis inside a steel cutting chamber designed to protect the operator. The cutting fluid drains to the base and is re-circulated, the chips being collected in a perforated tray.

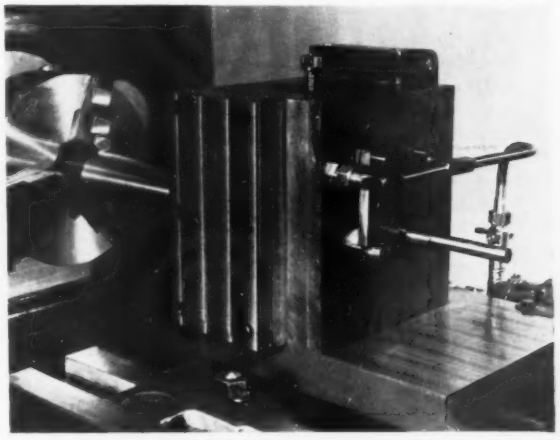
Cutting proceeds until about 50 grams of chips are produced. These are then washed, dried, weighed, and exposed to a scintillating counter. The radio-activity of the chips is recorded as pulses per second and the calculated tool wear expressed as counts per minute per gram of chips.

Precautions

Although the total radio-activity is not high, the greatest precautions are taken to protect personnel. All materials used in the construction of the test laboratory are impervious and readily decontaminated and protective clothing is provided. Each operator carries a personal dosimeter.

All radio-active tools are stored in a special lead chamber from which they can be withdrawn with a tool holder from a safe distance.

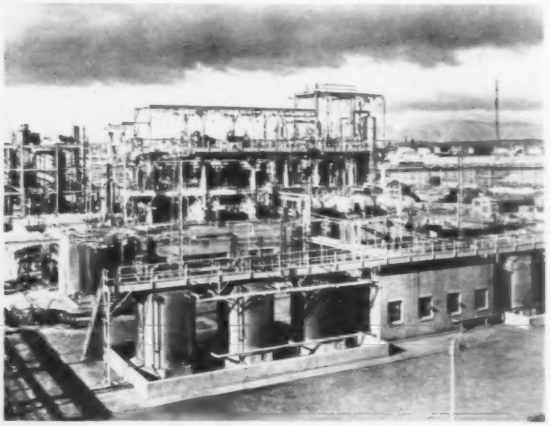
The cutting chamber closed ready for the machining operation.



Chemicals from Petroleum at Grangemouth

The Factories of the BHC Group

Three interesting and integrated factories for the manufacture of chemicals from petroleum are located at Grangemouth, on the River Forth. One of these is the works of British Hydrocarbon Chemicals Ltd, jointly owned in equal shares by the British Petroleum Company Ltd and by the Distillers Company Ltd. In this factory a light petroleum distillate from Grangemouth Petroleum Refinery Ltd, whose refinery adjoins the chemical plant, is converted into ethylene and propylene feedstocks for BHC's own use and for



The isopropyl alcohol plant of British Hydrocarbon Chemicals Ltd.

use by the adjacent works of Forth Chemicals Ltd and Grange Chemicals Ltd. The plants of the two latter are located within the same boundary fence as British Hydrocarbon Chemicals Ltd. Steam and power for the operation of the three plants is supplied from the Grangemouth refinery.

British Hydrocarbon Chemicals Ltd itself produces ethyl alcohol, isopropyl alcohol, tetrapropylene, diethyl ether, dicyclopentadiene, and cracked spirit.

Forth Chemicals Ltd, which is concerned with the manufacture of styrene monomer for use in the plastics industry, is owned two-thirds by BHC and one-third by Monsanto Chemicals Ltd. BHC is also the majority holder (two-thirds) in Grange Chemicals Ltd, which makes detergent alkylate and light alkylate, the other one-third being held by the Oronite Chemical Company, a subsidiary of Standard Oil Company of California.

Gemec Ltd, a subsidiary of Union Carbide Ltd, are at present building a polymerization plant in the area and will take ethylene from BHC for conversion to polyethylene.

In order to cope with ever-increasing demands for products, an extensive programme of expansion is in progress, BHC is to duplicate most of its plant and Forth Chemicals Ltd is to more than double the initial capacity of its styrene plant.

Operations at BHC

The petroleum distillate, consisting mainly of saturated hydrocarbons, is mixed with steam and cracked at a temperature of 1350°F, the product being a gaseous mixture of ethylene, propylene, and other compounds. This mixture is quickly cooled by heat exchange with an organic chemical heat transfer medium to an intermediate temperature, and then by contact with cold quench oil to 270°F. The heat removed by the heat transfer medium is used to produce steam in a steam generator. The quench oil is recovered in a quench tower for re-use while the gases pass forward to a gas separation plant.

Gas Separation

In the gas separation plant the gas is first relieved of its distillate and fuel oil and these products are returned to the refinery for incorporation in the normal output of that plant. Sulphuretted hydrogen is then removed from the gas mixture by caustic soda treatment and the gas dehydrated by alumina driers to a dew point of below—75°F. Complete dehydration is important in order to avoid any risk of ice formation in subsequent treatment.

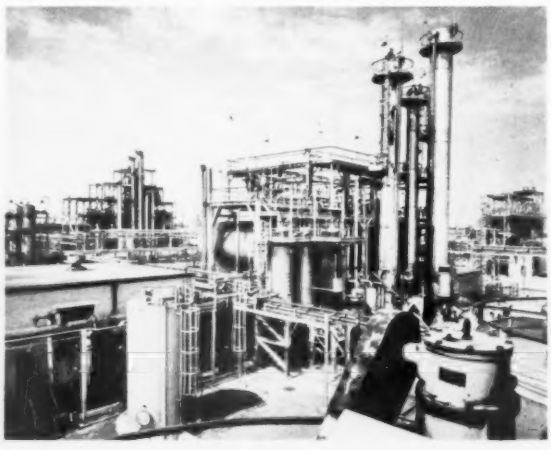
The gas mixture is then compressed and cooled to—150°F by refrigeration with liquid propylene and liquid ethylene. The liquefied gas is then distilled in very efficient columns operating at pressures up to 500 p.s.i. to produce pure ethylene and propylene and small quantities of other fractions containing hydrocarbons of higher molecular weight.

Ethylene Utilization

The ethylene fraction passes to a synthetic ethyl alcohol unit where it is mixed with water in the presence of a catalyst to produce a weak aqueous solution of ethyl alcohol. This solution is purified by rectification to produce very pure alcohol (ethanol) containing 92·4 per cent of pure alcohol.

Coincident with the manufacture of ethyl alcohol a small amount of diethyl ether is produced and this is recovered and marketed.

British Hydrocarbon Chemicals Ltd ethanol plant (centre) *and its cracking unit* (left background)



Propylene Utilization

Part of the propylene fraction is converted into isopropyl alcohol by the acid process. In this process, the propylene and sulphuric acid are contacted in counter-current flow. The propyl hydrogen sulphate so formed is diluted with water, the acid regenerated as a dilute solution, and isopropyl alcohol produced. After purification and fractional distillation, a constant-boiling mixture of 87 per cent isopropyl alcohol and 13 per cent water is obtained. The regenerated acid is reconcentrated for re-use.

For the production of tetrapropylene (or "tetramer"), propylene is polymerized with phosphoric acid catalyst in a UOP poly plant. The product consists of a mixture of polymers which is separated by distillation and the tetramer finished to a close specification.

Butadiene and Cyclopentadiene

From the gas separators a butene-butane fraction is extracted from the residual light hydrocarbons remaining after separation of ethylene. A plant is now being erected for the extraction of butadiene from this fraction.

A pentene fraction is recovered from the residual heavy hydrocarbons from the gas separators and is given a thermal polymerization to yield dicyclopentadiene.

Disposal of Products

BHC's principal products, ethyl alcohol and isopropyl alcohol, are dispatched by road, rail, and sea to The Distillers Company Ltd and their associates British Industrial Solvents. Ethyl alcohol is pumped from bonded storage to rail or road wagon loading racks, some delivery being made direct by pump-over to nearby bonded storage of The Distillers Company. The isopropyl alcohol goes by sea-going tanker from Grangemouth Docks to Hull for the manufacture of acetone.

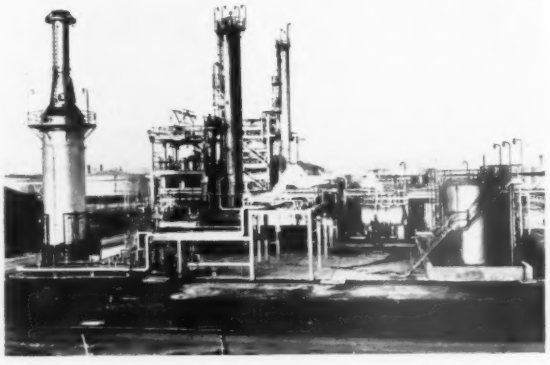
Other products are also despatched by road, rail, or sea as required.

Ethylene

At present the main use of the ethylene produced is for the production of ethyl alcohol, which is marketed for use in the manufacture of general chemicals. A further quantity is passed to Forth Chemicals Ltd for use in styrene manufacture.

In this plant detergent alkylate is manufactured by Grange Chemicals Ltd.

A BP photo



In that plant the ethylene (C_2H_4) is combined with benzene (C_6H_6) to form ethyl benzene ($C_6H_5{:}C_2H_5$), which is then dehydrogenated to form styrene ($C_6H_5CH{:}CH_2$).

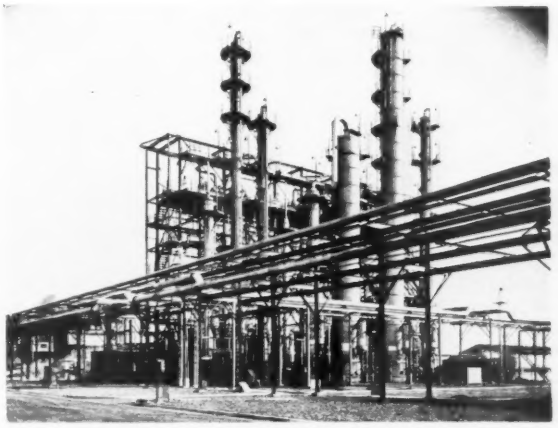
A third and future use for BHC's ethylene output is for polyethylene production in the new Gemec Ltd plant.

Propylene

About half of the propylene produced is converted to isopropyl alcohol (C_3H_7OH) while the balance is polymerized to tetrapropylene ($C_{12}H_{24}$).

The isopropyl alcohol is an important chemical which can replace ethyl alcohol in many applications. The main uses of isopropyl alcohol are in acetone and ester manufacture and as an intermediate in general chemicals production.

Tetrapropylene ($C_{12}H_{24}$) from the tetramer plant is supplied to Grange Chemicals Ltd where it is reacted with benzene (C_6H_6) and converted into dodecylbenzene ($C_6H_5{:}C_{12}H_{25}$). This hydrocarbon is an intermediate in the production of synthetic detergents of the alkyl-aryl sulphonate type.



Courtesy Monsanto Chemicals Ltd.

A general view of the styrene plant of Forth Chemicals Ltd.

Cyclopentadiene

This hydrocarbon is marketed in the form of dicyclopentadiene. On heating dicyclopentadiene the cyclopentadiene is easily regenerated and finds its use in the making of drying oils, resins, insecticides, lubricating oil additives, and pharmaceuticals.

Ancillary Services

Well-equipped laboratories are provided for normal routine analysis and product control. A separate research department also exists for the development of new and improved processes and products and a new research laboratory is in course of construction. Excellent workshop facilities are also available for handling the specialized equipment used in the chemical plants.

Safety precautions and fire fighting facilities are fully capable of dealing with any emergency. Two modern fire tenders carrying foam solution are always ready for action and water hydrants are located at strategic points.

For the 700 personnel, which will be increased to about 900 when expansion is complete, there are very fine welfare, canteen, first aid, and similar facilities.

Books and Films

Who's Who in the Gas Industry

The 1956 edition of this very handy and useful guide to personnel in the British gas industry has recently been published. Full details are given of the officials of the Gas Council and of the Area Gas Boards, and a buyer's guide is included. Price is 5*s*. and publishers are Arrow Press Ltd, 1 Stamford Street, London, S.E.1.

Assignment World Wide

Under this title an interesting exhibition of photographs taken by Shell photographers—Derrick Knight, Norman Bunch, Clive Cadwallader, and Eric Wilmott—was recently held in the London headquarters of Ilford Ltd. Opening the exhibition, F. J. Stephens, a managing director of The Shell Petroleum Co Ltd, pointed out how apt the title of the exhibition was, for Shell photographers travelled all over the world. In fact, at that moment one was in Egypt and one in Uganda.

City and Guilds Broadsheet

The City and Guilds of London Institute has commenced issue of the *City and Guilds Broadsheet*, which it hopes to publish five times a year and which will report on a selection of the very wide activities of the Institute. It is estimated that at any one time over a quarter of a million persons in industry are taking courses held by the City and Guilds in various colleges and that the Institute has 100,000 candidates annually for its examinations.

The Broadsheet should be of considerable interest to employer and employee alike and copies may be obtained from the Institute at Gresham College, Basinghall Street, London, E.C.2.

ENI 1955

This publication of 92 pages of pictures and eleven pages of text attractively illustrates the progress of Ente Nazionale Idrocarburi (ENI), the Italian national agency for the production and utilization of hydrocarbons, which was established by law in 1953.

The Company's report for the year ended 30 April 1955 has also just been published. In this nearly 100 pages are devoted to its activities in that period.

British Scientific Instruments

Details of the products of the members of the Scientific Instrument Manufacturers Association of Great Britain (SIMA) are given in the 412-page 1956 Directory and Handbook just issued. A classified index of these products occupies 76 pages and a further 68 pages are devoted to glossaries of the classified headings in French, German, and Spanish. The remainder of the publication consists of illustrated announcements by the members. Price of this useful guide to British scientific instruments is 22*s*. 6*d*. post free and copies are obtainable from SIMA, 20 Queen Anne Street, London, W. 1.

Information Book—Petroleum

The scheme of the "Information Books" published by The Educational Supply Association Ltd is to provide "Accurate, simply-presented information, which will help satisfy children's natural curiosity". A recent addition to the series is the volume on "Petroleum" by W. W. Evans, B.A., M.Inst.Pet., who in eleven chapters presents the interesting and simple story of petroleum from "what it is" to "how we use it". A twelfth chapter deals with the people in the industry and a short glossary of terms completes the work.

This book serves its purpose admirably, it is well illustrated, and it should serve to bring to the enquiring mind of the young reader much useful information on the industry. Printed in easily-readable type and bound in a durable semi-limp cover, the price is 5*s*. 6*d*.

Oil Burning Recommendations

Revised recommendations for installations burning liquid fuel with a flash point not below 150° F have been drawn up by the Fire Offices' Committee. They are contained in a leaflet entitled "Recommendations in Connection with Liquid Fuel (including coal tar fuels) having a flash point not below 150° F (closed test)". Copies are obtainable free on application to the Fire Protection Association, 15 Queen Street, London, E.C.4.

Chemical Apparatus and Equipment Practice

Number 9 in the series "Ergebnisse von Einzelfragen des Chemischen Apparatewesens" has recently been published by the DECHEMA Deutsche Gesellschaft für chemisches Apparatewesen, Frankfurt am Main.

Among the subjects discussed in this number are: the prevention of incrustation in evaporators, filtration of highly viscous solutions, and the prevention of corrosion in boilers.

Fuel Efficiency Exhibition

A fuel efficiency exhibition is to be held at Olympia from 2 to 10 October this year under the auspices of the National Industrial Fuel Efficiency Service and the Combustion Engineering Association.

The exhibition will deal with fuel efficiency in industry and will concentrate upon equipment to reduce air pollution and cut fuel bills.

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EX-OFFICIO MEMBERS OF COUNCIL

Some years ago the Council of the Institute decided, under Article of Association 23 (C), to nominate at each Annual General Meeting, six ex-officio members of Council to represent the six Branches then situated in the United Kingdom.

Since that time the situation has changed considerably and there are now seven Branches and one Student's Section in Great Britain, with four Branches overseas.

For some considerable time the various individuals elected to Council as ex officio members have, therefore, been looked upon not as specific Branch representatives, but as representatives of the Branches Committee, which is charged with the responsibility of looking after the interests of all the Branches.

As it would obviously be impossible for officers of overseas Branches to attend Council meetings, six of the United Kingdom Branches now nominate each year, on a rotation basis, one of their officers to represent the Branches Committee on Council.

Esso Board Changes

It has been announced by Esso Petroleum Co Ltd that following the retirement of W. E. Jenkins, C.B.E., from his position as a managing director of the Company, H. C. Tett and R. J. Pinder have been appointed managing directors. At the same time C. Chilvers, manager, Co-ordination and Economics Department, has been appointed to the Board of Directors.

W. E. Jenkins

Mr Jenkins, who was appointed a director in 1945, first joined the Company in 1920 and was appointed secretary in 1933. After a special assignment abroad, he became comptroller and secretary in 1936.

On the outbreak of the second world war he was appointed Petroleum Board Controller, Finance and Accounts, and for these services was awarded the C.B.E.

H. C. Tett

Mr Tett joined the Anglo-American Oil Company in 1928 as an assistant in the Technical Sales Department, later becoming manager of the department. During the second world war he served as a member of the Technical Advisory Committee of the Petroleum Board, the Aviation Supply Committee, and the Inter-Services Co-ordination of Specifications Committee.

In 1947, when the Esso Development Company was formed to conduct and co-ordinate the Esso group's research and development in Europe, Mr Tett was appointed its managing director. In 1949 Mr Tett returned to Esso Petroleum Company as general sales manager and was appointed to the board of Directors in 1951.

Mr Tett has been a member of the Institute since 1928. He was a member of Council from 1937 to 1953, a vice-president from 1947 to 1953, and chairman of Council in the period 1948-9.

R. J. Pinder

Mr Pinder joined the Company's Birmingham office as a clerk in 1920. He later held important positions in the Company's sales organization and in 1937 was appointed executive assistant to the International Association (Petroleum Industry) Ltd where he was concerned with marketing problems of the Esso Organization in many European countries.

In 1945 he returned to Esso Petroleum Company to assist the reorganization of the sales Department on the dissolution of the Petroleum Board. He was appointed deputy general sales manager in 1950 and became sales manager in 1951. In 1953 he was appointed to the Board of Directors.

C. Chilvers

Mr Chilvers first joined the Anglo-American Oil Company as a chemist in 1926 and was appointed manager of the Technical Sales Department in 1939.

During the war he served with the Petroleum Board as Joint manager of the Chemical Department, and on returning to the Company was successively manager, Costs and Operations Department, and manager, Co-ordination and Economics Department.

Mr Chilvers is Honorary Secretary of the Institute. He first joined the Institute in 1926 and became a member of Council in 1946. He held the office of Joint Honorary Secretary in 1946 and has been Honorary Secretary of the Institute since 1947.

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Personal Notes

F. N. Judson, M.B.E., has retired from his position as general sales manager (Industrial) with the Mobil Oil Company. He is succeeded by **G. M. McGavin.** Two years ago Mr Judson celebrated 40 years of distinguished and varied service with the Company, and in recognition of his contribution to the affairs of the oil industry throughout these years, he was awarded an M.B.E. in the 1956 New Year's Honours List.

G. M. McGavin joined the Company in 1946 as marine sales engineer and in the same year was appointed marine branch sales manager at the Company's Liverpool Office. Two years later he came to London to Mobil's Marine Sales Office in the City, and was later appointed chief marine engineer. In 1954 Mr McGavin was transferred to the Company's headquarters and, in the autumn of the following year, was officially appointed general sales manager (Industrial).

Commodore W. A. Michie has retired from the British Tanker Company, the shipping organization of The British Petroleum Group.

Commodore Michie began his seagoing career at the age of 16 as a navigating apprentice with E. T. Radcliffe & Company of Cardiff. After service as a junior officer in the Merchant Navy during the first world war, he joined the British Tanker

Company in August 1918. He received his first command in 1928 and during the second world war served at sea as Master in a number of the Company's ships. In 1946 he was made one of the Company's senior post masters and in 1954, was appointed Commodore of the Company's fleet, his last command being the 32,000-dwt tanker *British Engineer*.

R. Scott has retired after 32 years of service with the Mobil Oil Company's Industrial Division in South Wales. Mr Scott joined the Company in 1924. He was promoted from field engineer to senior engineer and in 1950 was appointed special representative for the Division.

Before joining the Company, Mr Scott was chief engineer on one of the earliest diesel tankers to sail from the U.K. to the Mexican Gulf and back, being among the first to hold a Chief Engineer's certificate with an endorsement for diesel engines. In his work for the Mobil Oil Company many of his solutions to lubrication problems were original and in the majority of cases proved to be so effective that they have since become standard practice. Mr Scott made a study of lubricants for steel and aluminium rolling and was responsible many years ago for developing this side of the business in South Wales.

J. Gosling, who last year completed 50 years service with Mobil Oil Company, has retired from his position as marketing assistant in the Company's Northern Industrial Division in Manchester.

J. C. Jewell

John C. Jewell, deputy chairman of the IP London Branch and lately its Honorary Treasurer, left London on 3 April to lead an expedition into the unknown regions of southern Peru. The particular area to be visited is the Cordillera Vilcanota and Caravaya near Cusco, the capital of the old Inca empire. In this area there are many unclimbed and un-named peaks and the expedition will carry out surveying and meteorological observations and will also undertake some botanical work, as little is known about the fauna of the higher Andes.

The British Andean Expedition is a private venture, although some support has been received from various firms, and Mr Jewell has been granted special leave of absence from his firm, Messrs C. C. Wakefield & Co Ltd, in whose Hayes laboratory he is a chemist. His companions on the expedition, which is expected to return to the U.K. in the middle of August, are Pat O'Donoghue, a dental surgeon, and Ralph Whitling, a schoolmaster, geographer, and surveyor. It is also intended to make a documentary 16-mm colour film of the expedition.

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LABOUR STATISTICS FOR THE U.K. PETROLEUM REFINING INDUSTRY

The following figures are taken from the March 1956 issue of the *Ministry of Labour Gazette* (cf. previous figures given in the *I.P. Review* (1955, **9**, 308)).

Figures in bold type are the averages for all the industries covered by the tables.

	Men (21 and over)	*Youths and Boys*	*Women (18 and over)*	*Girls*	*All Workers*
No. of wage-earners covered by remuneration statistics	17,146	698	904	18	18,766
Average earnings in last pay-week in October, 1955 (shillings)	232/10 **222/11**	99/1 **94/2**	120/11 **115/5**	— **75/8**	222/4 **187/2**
Average number of hours worked in this pay-week	49·0 **48·9**	45·7 **45·0**	44·9 **41·8**	— **42·7**	48·7 **46·9**
Average hourly earnings in this pay-week (pence)	57·0 **54·7**	26·0 **25·1**	32·3 **33·1**	— **21·3**	54·8 **47·9**
			Males	*Females*	
Numbers employed (Jan. 1956)			31,500	6,400	37,900
Numbers unemployed (at 13 Feb. 1956)			184	25	209
Labour turnover rate (5 weeks ended 31 Dec. 1955)					
No. of engagements per 100 employed			1·1 **1·9**	0·7 **2·5**	1·0 **2·1**
No. of discharges and other loss per 100 employed			1·2 **2·0**	2·1 **3·9**	1·3 **2·6**

The Economic Impact of Oil on the Arab Middle East

By JOHN MURRAY, O.B.E. (*Fellow*)

Part III The Effect of the Companies *(concluded)*

Men and Manners

Thus far we have dealt with those elements in the direct impact of the industry which are purely economic and virtually financial and commercial; there are others, however, which are predominantly social but have so much economic connotation that they must also be considered here. The Middle East is now undergoing a social change which is racked by many cross-currents and brought about by many causes; of these the presence and example of the oil companies and the funds which they indirectly provide for development, education, and travel are one, though only one. This is not the place in which to assess such elements in the intellectual ferment as the rise of a middle class, the change in the attitude to religion, the up-surge of nationalism or the awakening of political consciousness in the feudal States, stimulated as they are by the general impact of the West and the voice of Egypt in radio, press, film, and education. The oil industry is, however, of importance as one source of new social ideals and one cause of new social conflicts; and these are equally of importance to it. Such problems, considered in general terms, are complex and fall outside the scope of this study;[14] but where specific social activities of the companies have an economic element they clearly cannot be omitted.

Employment and Habits

Much of the socio-economic influence of the companies is exercised, consciously or unconsciously, through their employment and example; and of these the former is an important factor in the life of the region. It was noted above that the oil industry is a major employer in a non-industrial society; as early as 1933 I.P.C., then constructing its outlets, was employing as many as 10,000 persons on the pipeline between Iraq and the Mediterranean coast and another 1000 on the Kirkuk field. Today this Company and its Associates employ 12,000 people in Iraq alone; Aramco in 1953 numbered some 3000 Americans and 25,000 other nationalities; and in the small states of Bahrain, Qatar, and Kuwait the oil companies employ respectively some 8000, 4500, and 8000 persons, local and foreign. Nor is employment negligible in Egypt, Syria, the Lebanon, or at the British Petroleum refinery in Aden.

The salaries and wages of a staff and labour force so large are an important element in inducing secondary prosperity in the countries in which the companies operate. Perhaps equally important is the example set in regard to relations between management and employees; the companies are uniformly good employers and their labour relations have pointed the way towards further developments. Joint consultative committees, welfare officers, elected groups representing the workers—these are all new things to the Middle East, almost within the post-war generation. Company standards are high, too, in regard not only to wages, which generally compare favourably with local rates, but in "fringe benefits" and amenities. Leave, sickness and disability plans, terminal benefits, sometimes pensions schemes—all these are supplemented by extensive physical advantages such as housing and house loan schemes, hospitals and free medical attention, transport to and from work (not always provided in the West though the Middle East worker often thinks it is), shopping centres and cinemas, mosques, schools, churches and clubs, sports facilities and recreation centres, or subsidized canteens. These vary according to locality, the existence of outside facilities, and the grade of personnel, but are always extensive and frequently much beyond what either manager or worker would receive (or expect) in Britain.

This employment and these amenities, especially in the Gulf and Saudi Arabia, have not only affected the outlook of the local employer, but have had some very interesting by-product effects on the worker himself. Thus "when the Arabian American Oil Company first employed Bedouin, it ...[found]...that they tired easily and could not put in an eight-hour day. After eating the company's meat for six months however, the workers became noticeably stronger. Under existing conditions the Bedouin eat virtually no beef, for the grass in most of Arabia is too sparse to support cattle. Furthermore, sheep, goats, and camels are too valuable to the Bedouin to be slaughtered except on ceremonial occasions".[15]* This point is confirmed also by Longrigg who writes that among the population of Qatar the provision of food, water, and housing has among other things produced "a gratifying improvement in workers' physique".[16] In more developed, semi-urban areas, however, the immediate effect of oil company employment may be not so much to raise physical standards as to add to the amenities and luxuries which the worker can buy. Thus it has been suggested that in Bahrain, while Bapco's minimum daily wage is based "largely on the cost of a diet containing the requisite number of calories to keep a man and his family properly nourished", the basic diet may not have changed substantially, but the extra money have been spent on such luxuries as wrist watches, bicycles, and cinemas.[17]

*"Year in, year out, the poorer type of Badawin . . . never gets a 'square meal' according to our standards. He probably has meat only when he can cadge it off somebody more fortunate than himself, or when his shaikh gives a dinner party" (Dickson, H. R. P., "The Arab of the Desert", p.54). "The poor Badawin, and the great majority of Badawin are poor, gets one meal a day consisting of dates and camel's milk, with a very occasional dish of plain rice or a piece of bread" (*ibid.*, p.189).

Iraq Petroleum Co. Ltd.

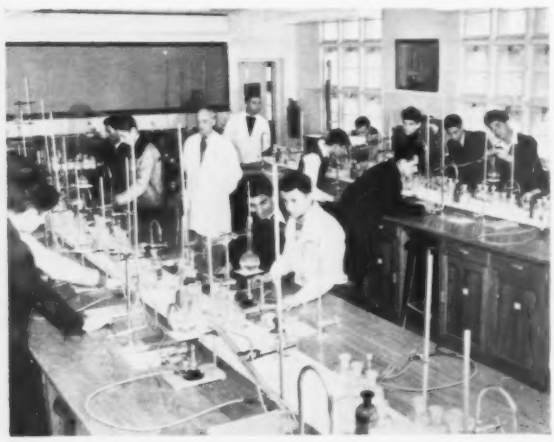
Mobile plant driver at Ahmadi

New skills are being learned and applied in workshops or fields

Another more important, because wider and more subtle, change is found in the agricultural and nomadic regions rather than in the towns. Regular human labour has always been essential in the cultivated areas, yet the peasant tends to be under-employed: his main object is to secure a subsistence and his efforts may be limited by the amount of work required to do so. Here industrial employment has developed a class of artisans whose capital is skill and who work regular hours in order to earn sums which can be spent on something more than mere subsistence. Where companies have to recruit among the Bedouin, the final effect is the same in that a stable skilled labour force is gradually created, with a purchasing power of its own; but the habit which has been altered

Laboratory in the Kirkuk training centre

Iraq Petroleum Co. Ltd.



is different since it is a tendency towards irregularity of work rather than steady under-employment which is being eliminated. This is not of course accomplished quickly; such mobility is ingrained in the character of the Bedouin, who may react as did those employed by C. S. Jarvis in the first war: "They learned carpentering and blacksmith's work with amazing ease, becoming quite expert in a year and receiving rates of pay that meant unlimited wealth to a nomad, but none of them stayed the course. Invariably, after eighteen months or two years, these budding craftsmen would disappear from their benches without previous warning and would later be discovered tending a flock of sheep in the desert for which they were being paid, if they were lucky enough to extort their wages at all, at the rate of £1 a year instead of the £6 a month they had been receiving as workmen".[18] There is no doubt that the previously free Bedu do not always like to be tied to a regular task undertaken for another; Bertram Thomas[19] thought that this might even be the reason for the persistence of slavery in the Arabian peninsula. But as such men experience and come to understand the value of oil company employment, and inevitably become more settled while so engaged, this attitude to tied work seems to change. In the early days the labour force of companies on the Gulf, recruited from men who wandered everywhere from Iraq to Aden, had a very high rate of turnover; today this has fallen, in a way so similar in the different companies "as to suggest that the governing factor is not the nature of the bait on offer but the rate at which the Gulf Arab is able to shed old habits. The rate of turnover tends to fall fast only when the advantages of a fixed dwelling and a savings scheme begin to impress the breadwinner."[20]

Manpower Supply and Demand

These habits among labour, even though breaking down, provide one answer to the question of why, with all the benefits they give, some of the largest producing companies should still have difficulty in local recruitment. The need to find staff and labour on a large scale has left the industry with some perpetuated problems: to start the operation going trained oilmen were needed and these could only come from abroad; consequently the staff grades were in the early days almost exclusively Western. The same difficulty sometimes applied in the case of skilled artisans and even regular labour; thus in some areas oil companies in their early days found almost no trained local men and a mobile labour force and were obliged to import Indians, Pakistanis, and Arabs from the Levant. In the western half of the Arab world, however, local skills are now available and the operation is not so large; consequently many staff (especially in Egypt and the Lebanon) and all skilled labour are today of local origin and often company trained. That this is not yet the case in Iraq or the Arabian Peninsula is not a matter of deliberate policy, for today all companies are trying to recruit both staff and labour locally and so reverse the trend of their historical inheritance. But in addition to the labour habits mentioned above the industry finds other difficulties.

The first of these is simply the shortage of technically trained men in the countries of the Middle East, resulting from the lack of education and the previous non-industrial nature of the society. This shortage is intensified by the common failing to regard such skills as a national asset which must be properly used; thus a student may proceed abroad at the expense of his Government, qualify as an agriculturalist, and after a short obligatory period in State service cease to work in his technical sphere and be drawn into commerce. Such

wastage frequently takes place within Governments, and technically trained officials find themselves moved from their specialized department to become general administrators.

This leakage from the limited technical reservoir indicates another difficulty of recent growth. It was said above that the wages—and indeed salaries—paid by the petroleum industry compared favourably with local rates. This was uniformly the case during the build-up period; today in certain countries where the labour market is limited, the very prosperity which the industry has created is making it increasingly difficult for it to find local recruits. This dilemma is common to the developing States and more particularly to those (Iraq and Kuwait) where the Government revenues are large and have been spread around in development and welfare projects. The companies, in fact, are beginning, so far as the basic wage is concerned, to have difficulty in competing with the State as employers, or with the disproportionate remuneration which educated Arabs can receive in the booming commerce of such cities as Kuwait or Baghdad. If all the benefits which oil companies give were expressed in cash their position would still be seen to be competitive; but the pay pattern is, in most cases, not that of the "clean wage" owing to the many advantages given in kind.

Another difficulty in the recruitment of local personnel is the inclination in certain *entrepôt* cities towards such work as shopkeeping and commerce. The town Kuwaiti, for example, is traditionally commercial rather than industrial so that even boat building for which the city is famous is done by a separate group (the Baharna). The indigenous townsman in such a city is a distributing trader, a sailor, or a merchant. To the Arabs, again, metal work is not traditional and may even be regarded as a "tinker's job"—though he seems to have less prejudice against work connected with automobiles: some magic attaches to the self-propelled vehicle so that even in areas without artisan tradition, it is not only considered a privilege to drive one but to perform on it mechanical jobs—washing, panel-beating, and repairing—which apparently are enriched and ennobled by contact with the modern ship of the desert.

Technical Training

These difficulties are not always easy to overcome, rooted as some of them are in basic economic realities or deeply ingrained prejudices. But the primary one, lack of skills, is clearly susceptible to direct action; and on this the oil industry is, in fact, making strenuous efforts and one of its best contributions, both economically and socially, to the development of the region. Virtually all companies now possess excellent technical training schools; and all are willing to accept the constant loss of trainees as a contribution to the general reservoir of skills.

Such schools differ in type of training given and the immediate object and standard aimed at; this is in part due to local circumstances and needs, in part to the degree of basic education on which the companies can count. Thus at Kirkuk, where State education has existed over a reasonable period, the principal aim of the well-equipped I.P.C. Training Centre is to take as apprentices boys who have already had several years' schooling, and bring them to a standard comparable with that of the National Certificate or the City and Guilds Certificate in the United Kingdom. These apprentices are therefore given a continuing education course with laboratory and workshop practice for two years; for three further years their work is more and more specialized

While under training some take their responsibilities solemnly

—some more cheerfully

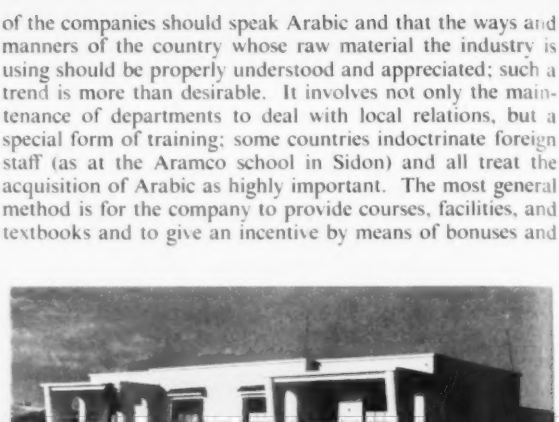
and more of their time is spent in the actual departments of the Company. The aim here is to produce senior technical labour or junior staff on the path to higher things, though the Company also runs less academic artisan training, commercial courses, and evening adult classes for older men already in employment. Similarly, the Suez Training Centre of Anglo-Egyptian Oilfields is also mainly designed to produce highly qualified artisans from apprentices who have already had a good school education: here again the course lasts several years and clearly gives the Company a firm basis for the eventual provision of its own technical staff—as well, it appears, as providing a source for recruitment of personnel by such parallel industries as the Egyptian Government refinery. This Company also aims at giving further technical training to its existing senior local staff.

In Kuwait the local educational background was until recent years very limited, and the aim has therefore been to give the basic elements of skill to the technically untrained Bedouin who form the chief local reservoir for the Company's recruitment. In this aim remarkable success has been obtained in the Company Training Centre at Magwa, where the majority of the recruits are illiterate Bedu boys. Neither these, the older men drawn from existing unskilled labour, nor the comparatively few boys directly recruited from the city, have as yet been products of the new State educational system; and indeed until this has been running for some years it will not be possible for the Company to find apprentice recruits of sufficient basic education for a training scheme on the Kirkuk or Suez lines. In these circumstances the Company has been obliged to skip the whole of formal education in one jump; and nothing of this kind in the Middle East is perhaps more remarkable than the sight of Bedouin youths with their long black ringlets quickly and accurately figuring by rote fractions in English numerals a few weeks after they have started the basic course which precedes the practical training in specialized trades.

A similar difficulty prevails in Saudi Arabia; and consequently Aramco has created a system which differs in method but not in aim. In this Company new employees receive a three months "vestibule training" and thereafter become regular workers who are trained on the job over a long period, spending one-eighth of their working time on instruction. A step beyond this "on the job" training lies in the Advanced Trade Training Unit run by the Company at Dhahran, which can lead further to scholarships in the United States or the Lebanon.

These are not of course the only oil company training centres in the Middle East, but have been specially mentioned because they represent particular responses to particular circumstances; equally noteworthy, for example, are the training schemes operated by Bapco, which include a craft training centre which takes employees on full pay for trade training as electricians or instrument men, a boiler-maker/pipe-fitter training school, a driver training school, an indoctrination centre for new employees, and more general classes in elementary English, arithmetic and the like.[21] Everywhere throughout the region the companies have shouldered this responsibility on a substantial scale; and everywhere they regard loss of trainees as an acceptable contribution to the local economy.

Such training if it produces Arab staff can have an important effect in furthering direct social relations. But difficulty in finding national colleagues is not the only lion in the path of social contact by the expatriate; and more and more it is the aim that the European and American staff of the companies should speak Arabic and that the ways and manners of the country whose raw material the industry is using should be properly understood and appreciated; such a trend is more than desirable. It involves not only the maintenance of departments to deal with local relations, but a special form of training; some countries indoctrinate foreign staff (as at the Aramco school in Sidon) and all treat the acquisition of Arabic as highly important. The most general method is for the company to provide courses, facilities, and textbooks and to give an incentive by means of bonuses and allowances; pressure may also be applied in the form of an indication to new recruits that their promotion is likely to be retarded by lack of Arabic, or a contractual obligation which makes at least elementary Arabic compulsory to all foreign staff.



A Shell photo

An artisan's house at Sudr

Houses and Hospitals

Many of the amenities provided by oil companies in the Middle East are in fact part of the conditions of employment; they may be given because they are what a good employer should give anywhere, or may be designed to meet the special conditions of the oil industry which so frequently finds its raw material in the most remote places. Such amenities always have a social effect, if only as an example, and may have an economic one, as when subsidized meals, cinemas, or company shops supplement local private enterprise or compete with it.

The socio-economic effect is particularly noteworthy in the case of three items. Of these, two—medical facilities and housing—are virtually essential ancillary services; the other, comparatively minor but not without influence, is the existence of savings groups or thrift schemes in almost all companies. The value of these is considerable: in addition to inculcating the habit of saving and indeed the idea of capital formation, they serve a particular purpose in preparing the way financially for house purchase schemes. Much more important are medical services; these are efficient, well-staffed, and well-equipped, and normally undertake all treatment of company staff and labour; though sometimes local facilities are also used, as when tuberculosis cases are sent to the sanatoria of the Lebanon. Most, if not all, companies extend their treatment also to the families of their staff and most to the wives and families of their labour; in doing so they are not to any degree open to the imputation of drawing away legitimate practice from the local doctors for the supply of these is usually miserably inadequate to the demand. Sometimes clinics are specially built, designed solely for the treatment of Arab wives and children; such is that of the Kuwait Oil Company at Ahmadi whose British nursing sisters form a

long range desert group of medicine, visiting sick women and treating tuberculosis in Bedouin encampments far out in the hinterland. In such ways as this oil companies can have a direct effect in improving hygiene through the cautious and delicate introduction of new techniques and new ideas.

Indeed such public health and preventive medicine work is particularly important in all the less developed States of the Persian Gulf. In Bahrain, Bapco has worked with the State on the provision of clean water and the control of malaria; and Aramco has made itself responsible on a large scale for public health improvement in eastern Arabia by malaria control, fly elimination, and sanitation programmes. The campaign against tuberculosis and the serious endemic diseases such as typhoid, smallpox, and trachoma is aided by professional co-operation through, for example, medical societies which aid liaison, not only between doctors of different oil companies but with the State medical authorities. Particularly noteworthy are the trachoma research being carried out by Harvard University in conjunction with Aramco, and the Order of St. John of Jerusalem Ophthalmic Hospital and research project, to which the oil industry is making generous contributions.[22]

Housing presents problems and effects which are made none the less by the fact that so many oilfields lie far from existing towns or villages. Of the effects the most straightforward has been economic; an immense stimulation has been given to local civil engineering by the building of housing estates; and the possession of good housing both by expatriates (which enables them to bring out their families) and nationals (which raises living standards and consequent consumption demands) has produced a good deal of secondary prosperity. This is typified by the locally-owned shops which have been drawn into many company estates. The social effects are more complex in that modern towns with Western amenities have been created everywhere from Sudr to Saudi Arabia, which have markedly influenced their inhabitants by experience and their neighbours by example. Even at small out-stations in the desert the construction of industrial buildings, housing, and water wells has had its effect; and the sociologist might make an interesting study of the influence of the desert stations on Tapline or the I.P.C. complex in providing halting places for traffic and water supply on which the nomads concentrate.

The problems involved in housing policy are complex. At first most companies provided housing for married expatriate staff with other accommodation for actual or enforced bachelors; wherever they operated far from a reservoir of labour they also provided some type of bachelor quarters for their labour force. But it was quickly realized that all grades of staff and labour must, to produce a settled and stable body of employees, be given proper houses where they could live with their families; and when this became the objective the companies almost everywhere embarked on extensive building programmes. Where no nearby towns existed this seemed the only way; but where they did, the building of oil towns has sometimes had the effect either of producing separated communities or of drawing off something of the life of the nearby city while contributing little to it. This problem is also being faced in various ways; and just as staff and labour housing estates, which in many companies were originally separated, now tend to grow into each other, so many companies have begun to encourage workers to live in the local community and provide transport facilities to bring them to their work. Where such local towns do not exist an effort may be made to create them; thus Aramco has in recent years encouraged the development of satellite villages and expansion of such existing communities as Dammam, in which their workers can live in reasonable proximity to their job.[23] Here a natural development now seems to be taking place, for private enterprise is putting up houses, offices, warehouses, and utilities. The planned encouragement of such satellites is probably desirable since their advent is natural and almost inevitable and may otherwise result in the uncontrolled growth of shanty towns on the fringes of company operations.

Encouragement of satisfactory fringe development does not mean that companies are today shirking what they regard as their obligations. Many elaborate programmes of low rental housing for labour and staff still continue; but the concept is now rather to supplement than replace the nearby town. Such housing is often above local standards and generally provided with amenities; but obviously those national staff and labour who wish to live in a village or town must be allowed to do so—even though their motives may sometimes be no higher than that they find irksome the not unreasonable restrictions on the destruction of carefully-nurtured trees, or the keeping of large flocks in estate back gardens. Several companies now give allowances to staff or labour, the whole or part of which is deducted as rental for the houses provided; if the employee wishes to live elsewhere, he retains the allowance as an aid towards his rent. As company rentals are low, however, these "livers-out" may be at a disadvantage as against their compatriots living in the well-equipped company houses; at least one company is making a specific additional payment to its national staff for this reason.

In the families' clinic at Ahmadi

Best solution of all is probably the development of the home ownership schemes and housing loan plans, which are perhaps furthest advanced in I.P.C. and its Associates in Iraq, and in Aramco, but are also being developed by Bapco and the Kuwait Oil Company and elsewhere. Such plans differ in detail but in essence consist of the company raising a loan on behalf of a national employee, whether staff or labour, to cover the cost of a building plot and the actual construction of a house. Against this he makes a down payment (towards which advance drawings of terminal benefits and existing thrift plans are of assistance) and repays the rest over a period of many years by deductions from his pay packet in keeping with his income and likely tenure of service. This scheme often includes the valuable additional benefits of cancellation, whether by an insurance policy or other means, of the outstanding portion of the loan in the event of the employee's untimely death and of the handling by the company of all the complicated and often expensive design, tendering, and legal formalities. Even such schemes have their difficulties: if an oilfield is some distance from the nearest town, for example, is the company to encourage employees to build their houses in or near its own housing areas or in the city? Where operations are not so remote and good transport facilities exist, however, home ownership schemes have already had, as in Kirkuk, a marked effect in the improvement of the local city and in making the oil workers a part, and a valuable part, of its community.

Companies and Governments

One aspect of relations between companies and governments is, of course, the negotiation of agreements or payment of revenues; but in fact the Middle East petroleum industry has many other contacts with governmental agencies. The use of public transport has already been mentioned; oil companies are also concerned in such matters as the provision or use of public utilities, the hire of telecommunication services, and the provision of public security; postal facilities, land registration, education, technical assistance—all these are fields in which the industry and governments meet.*

Many of these relations are today undergoing a process of change. Nearly all oil companies in the Middle East have been forced for historical or operational reasons to provide many services for themselves: some began to operate before governmental services existed; much work is carried out in desert locations where it would be unreasonable to expect even the best-equipped government to provide electricity and water; and Middle East utilities, where existing, are often inadequate. Such self-sufficiency has been inevitable in practice; but it is generally agreed today that when it is possible to use a governmental or municipal service without detriment to local needs or operational efficiency, this should now be done.

Oil company practice today inevitably differs according to location. Aramco, with its great installations in originally empty country, and the Kuwait Oil Company working twenty miles from the city and established long before the latter had adequate power or any local supply of drinking water at all, are forced to have their own power stations, their own wells and water reticulation, their own distillation plants, and the like; for obvious reasons a similar situation obtains in most of the other operating areas of the Persian Gulf and at all the pipeline stations of both Tapline and I.P.C. Sometimes local circumstances and the desire to help have made companies go further so that they not only generate their own power and pump or distil their own water, but supply the nearby community. Thus at Kirkuk the whole electrical load of the city has been borne up to now by I.P.C., while both this Company and the Kuwait Oil Company formerly supplied drinking water to the neighbouring city. Such a situation, though reflecting company helpfulness, is in effect back-front in that normally a private company is more likely to buy water and power from a public utility than be in the utility business itself. Gradually, as countries develop, this position is being neutralized or even reversed: Kuwait now has a distillation plant larger than the Company's and no longer needs help; the Iraq Government is to build a power station at Dibbis near Kirkuk and the city has with I.P.C. assistance obtained its own water supply. The key to the position is undoubtedly the combination of date of commencement and remoteness of operation; it is significant, for example, that an advanced degree of integration in the use of both local water and electricity has been achieved in Basrah, where the Company headquarters and depot are situated in an already existing and developed city, and where the oil development expansion did not begin until a few years ago.

Education is, of course, accepted by private enterprise as being in normal circumstances a government function; but oil companies in the Middle East have been obliged to participate in this on occasion. As the manpower of pipeline stations or desert fields grew and population began to accumulate, the problem of schooling arose. Children congregated in areas where schools did not exist nor would ever have been built, and this as a direct after-effect of the operation. To meet the implied obligation, many companies have provided schools for the teaching of local children, leaving to the Government, however, the employment of teachers and direction of curricula. In some areas schools have been provided also for expatriate children (American, British, Indian, Pakistani), though this is intended more as an amenity for foreign staff than as a relief to the State of a burden of company creation.

In some of the foregoing there is an element of technical assistance; this indeed extends beyond governmental liaison, and has been wide-spread from an early date. Before Kuwait stood so lustily on its own feet the Company provided it with large quantities of fresh water, built the road which now links its installations to the town, and did much pioneering work in the provision of modern amenities and minor technical help. It may be regarded as technical assistance by example that this Company has also developed a very successful nursery using the local brackish water, which is regarded as a show-place to which visitors come from the town. In one day in 1955, this nursery had as many as 1700 visitors; and there is something of pathos in the thought that so little greenery exists in this desert country that townsmen should drive twenty miles to be photographed in front of a flowering bush. Such direct or indirect technical assistance is typical of all companies; Aramco, for example, has given the Saudi Government technical help in many large schemes financed by its own royalties. Thus the port of Dammam and the railway from Dammam to Riyadh were both constructed by the Company as an agent for the Government; nor are these minor projects, for the Dammam pier and causeway stretch for eight miles and the standard gauge railway

*The general effect on the balance of payments of foreign exchange accruing from local expenditure and royalties will be considered in Part V.

A Kuwaiti telephone engineer

is over 350 miles long. In dry and trhisty lands company water wells have helped to provide the most important of the elements; and everywhere from Qatar to the Lebanon company officials from time to time advise governments, assist in emergencies, lend or hire equipment, and provide in some ways a private enterprise Point Four. The less advanced the country the more important is such direct technical assistance; when the State is more advanced it is undesirable that companies which are fairly dividing their profits should be looked upon merely as a milch-cow, and a better basis for contact lies perhaps in the establishment of professional societies and in the normal technical contacts between engineers and scientists, between company technicians and government officials. In this and in other ways it should be part of the aim of the oil companies, in the social revolution which, willy-nilly, they are partly creating, to bring skills and development to such a point that the company can turn to a local man as the expert and say to him, "What do you advise, what can you do for us on this?"

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[15] Sanger, R. H., "The Arabian Peninsula", p. 87.
[16] Longrigg, S. H., "Oil in the Middle East", pp. 229-230.
[17] Hay, Sir Rupert, "The Impact of the Oil Industry on the Persian Gulf Shakyhdoms", *Middle East Journal*, 1955, **9**, (4) 364.
[18] Jarvis, C. S., "Desert and Delta", 1942 edition, p. 136; this passage is also quoted by Bonne, A., "State and Economics in the Middle East", 1948 edition, p. 155, where the same point is brought out.
[19] Thomas, Bertram, "The Arab", 1937, p. 266: "The peninsula Arabs are in the main far too proud to work as servants, far too independent in spirit to obey a master . . ."
[20] Monroe, Elizabeth, "The Shaikhdom of Kuwait", *International Affairs*, 1954, 30, (3) 283.
[21] Company documents can in most cases be found giving considerably more information than the foregoing: see for example Bahrain Petroleum Company Annual Report for 1954, pp. 25 to 29; "The Story of Kuwait", pub. Kuwait Oil Company Limited, pp. 42 to 46; "Iraq Oil in 1953", pub. Iraq Petroleum Company Limited, pp. 5 to 14; "Aramco and World Oil", vol. I, pp. 92 to 94.
[22] The Order of St. John scheme is a major effort in the campaign against trachoma: a large sum is being provided by the Order itself, but Iranian Oil Participants, the Iraq Petroleum Company, the Kuwait Oil Company, and Shell are all donating substantial amounts: see *The Times*, 1956, 31 January, 28 March.
[23] "Aramco and World Oil", vol. I, p. 99.

Part IV Fuel and Power

In Part I of this study it was shown that development of the Middle East and a rise in its living standards have in the past few centuries been retarded by many deficiencies—shortage of cultivable land, lack of water, weaknesses in social structure, and low agricultural productivity. Important among these has been lack of fuel: except in Iran there are almost no coal deposits in the region and many forests have been long since destroyed by human or natural causes. These shortages have affected even the supply of fuel for domestic heating and cooking so that the vicinity of villages is often stripped of small brushwood for bakers' ovens (with inevitable erosion consequences) while animal manure which should enrich the soil is burned under the cooking-pots of the peasant and Bedouin. More serious in long-term development has been the lack of fuel as a source of energy; nor is the water power which turned the mill wheels of Old England generally available as a substitute. Until recent years the main source of power for both industry and transportation in the Middle East was simply the physical effort of man and animal; and even in the present century, when a railway system, a few mechanized industries, and some power stations and gasworks began to develop in the region, their fuel needs were at first met by the import of coal from Europe or in emergency by the denudation of woodland.

Inevitably development of industry has been retarded. It is idle to suppose that the Middle East could, even with abundant fuel in past ages, have grown into a great industrial region, for there are other adverse factors—the lack of raw materials, the difficulty in moving goods, the low purchasing power of the peasants which restricts the market, the parallel difficulty in capital formation, and the competitive position of the highly skilled artisans of the West: but some degree of industrialization could certainly have developed had coal, for example, been available. Such industry as exists to-day is of two types, of which the older and more widespread is the group of handicrafts of which metal-working, the weaving of textiles and carpets and the preparation of foodstuffs are the most important. These bazaar industries are individually small in

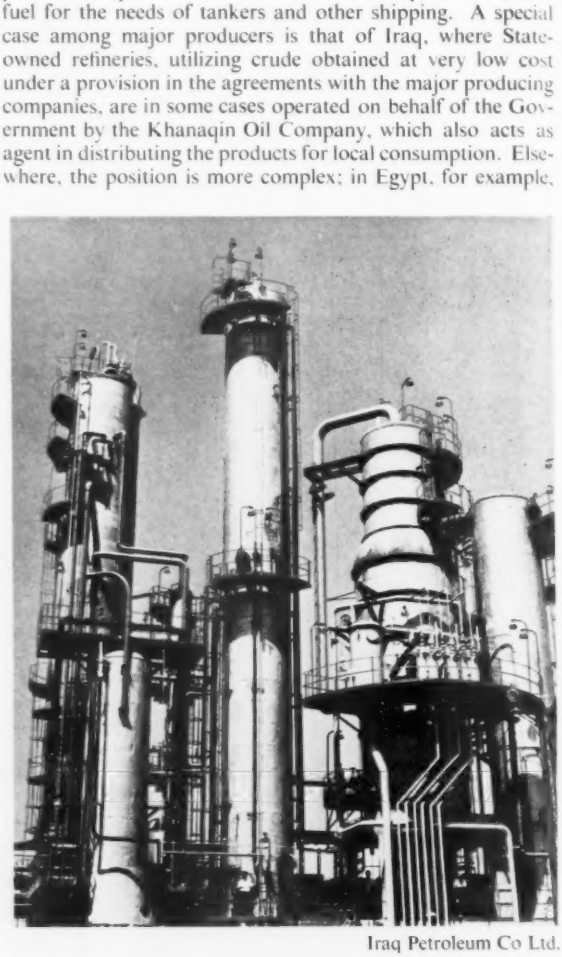
scale; but collectively they form by far the larger sector: even in developing Iraq the 1954 Industrial Census showed that out of 23,600 establishments, only 270 employed over 20 persons.[1] The prevalence of these handicrafts is a natural consequence of the lack of coal: they can "get along" on charcoal, large scale factory production can not. Nevertheless, this second type of industry has begun to develop in the Middle East during the last forty years, partly as a result of deliberate programmes undertaken for nationalistic reasons and partly owing to the cutting-off of imports during the second world war and the consequent need for the area to fend for itself in the manufacture of small articles. In the latter development, which took place mainly in Egypt, the Lebanon, and the Jewish sector of Palestine, a large part was played by the Middle East Supply Centre which not only stimulated local industry to meet the unsatisfied civil demand, but canalized thereto many military requirements in order to save shipping space. Some of this progress was lost after the war, but some has continued; and further activities are now being stimulated by a fresh nationalistic impulse towards self sufficiency, the adverse balance of payments position in certain countries, and the desire to spend oil revenues in balanced fashion on industry as well as agriculture.

Oil—the new source of fuel

A new major factor in the growth of this second kind of industry—and in the improvement of living standards generally—is the discovery and development of petroleum: here is a fresh energy source; the Middle East no longer lacks fuel for it can use its own oil. In consequence of favourable local sale clauses in agreements, petroleum products are usually cheap (though Governments have been known to spite their own faces by the application of prohibitive duties); they are also unquestionably abundant. The effects of this new supply are likely to be far-reaching; to-day "petroleum constitutes by far the most important source of energy used in the Middle Eastern countries. . . . Petroleum provides a source of fuel . . . for motor vehicles, domestic uses, the production of electricity in the cities, and, in some countries, for agricultural pumping machinery and small-scale industries."[2]

The extent to which oil has replaced coal—insofar as this was used—and the rapid increase in total energy consumption resulting from its local availability, are dramatically illustrated by figures quoted in a United Nations publication.[3] In 1937 Egypt used 1,311,000 metric tons of coal and 736,000 tons of liquid fuels*; by 1950 not only had total consumption more than doubled, but coal had almost disappeared as a source, the corresponding figures being 178,000 and 4,244,000 metric tons*. On a smaller scale, but proportionately more striking, was the change in Syria and the Lebanon, and Iraq, where coal consumption had virtually vanished by 1950, while that of liquid fuels was nearly six times the 1937 figure for the two former countries and seven times in the latter. Yet so low was the earlier energy supply that these rises only brought Middle East *per capita* consumption of oil in 1950 up to one half the world average of about 160 kilograms.[4]

Methods of supply of this new fuel differ according to country. In some States the producing company is the only petroleum operator and undertakes itself the internal distribution of products. This is the case, for example, in Kuwait where all products except such special items as lubricants are produced by the Company's own refinery and distributed cheaply through its filling stations in the city; in Saudi Arabia, Aramco provides from its refineries the wholesale supply of petroleum products, which are retailed by Saudi dealers; and in Bahrain supplies drawn from the Bapco refinery are distributed through filling stations, run by local private enterprise. All these refineries also produce bunker fuel for the needs of tankers and other shipping. A special case among major producers is that of Iraq, where State-owned refineries, utilizing crude obtained at very low cost under a provision in the agreements with the major producing companies, are in some cases operated on behalf of the Government by the Khanaqin Oil Company, which also acts as agent in distributing the products for local consumption. Elsewhere, the position is more complex; in Egypt, for example,



Iraq Petroleum Co Ltd.

The new Iraq Government refinery at Baghdad.

while the two principal producers are also distributors of products mainly refined from local or imported crude in the Anglo-Egyptian Oilfields installations, there are several other distributing companies, which may draw their supplies from the Government refinery at Suez or from imports. In the non-producers, Syria, the Lebanon, and Jordan, distribution is by many companies, major and minor, drawing their supplies from either the I.P.C. refinery at Tripoli and the new Medreco installation at Didon, or from imports.

The domestic consumption pattern

The demand for the products so distributed is rising everywhere: even in tiny Bahrain, where domestic consumption is of course small, local sales of petroleum products in 1954 showed a 22 per cent increase over 1953;[5] while in Kuwait the prosperity engendered by the influx of oil revenues has produced a sharp rise in the demand for motor spirit and kerosine in each of the last few years—and for bitumen for the

* Coal equivalents in metric tons, not actuals.

State's broad new carriageways. It is not in such countries, however, that a large utilization of industrial fuels must be expected; for this we must turn to the Lebanon, where the total 1955 domestic consumption of 430,000 metric tons included 104,900 tons of industrial and automotive gas oil and 148,600 tons of industrial fuel oil.[6] In this country, while the consumption of motor gasoline has been almost constant since 1951, there has been a very sharp rise in the use of fuel oil and still more in that of gas oil, of which the 1955 consumption was in fact more than double that for 1952. These rises reflect industrialization, the thermal generation of electricity, and possibly also the building development in Beirut and the consequent increase in central heating demands. A parallel rise in the consumption of aviation spirit no doubt results from the establishment of Khaldé Airport as the main aviation centre of the Middle East; 13,358 aircraft landed there in 1954 as against 3211 in 1951.[7] Except for a few specialized products, the whole of Lebanese consumption is now refined domestically; the country is indeed an exporter of some refined products to Syria and (to a limited extent only) to Jordan.

In regard to fuel, Jordan is, in fact, as in other respects, in a somewhat melancholy position; there is no local production, nor very much chance of it, and no domestic refinery, although the establishment of a plant to process the Government's entitled off-take from transit pipelines has been under discussion for some time. In the meantime, however, the country has to import all its fuel and lubricants, some from the refineries in the Lebanon but the bulk as an actual seaborne import through Beirut. As early as 1951, when the total imports were only half what they were in 1955, fuel and lubricants cost Jordan JD 1,405,000 out of a total of declared imports of JD 15,552,000. Transport is a large consumer in this country; of a total domestic consumption of 127,400 metric tons in 1955[8] motor gasoline represented 36,500 tons and automotive gas oil 3200 tons, while industrial fuel oil consumption at 2100 tons was only one-seventieth that of the Lebanon in the same year. This comparison, however, undervalues Jordan's admittedly small industry: there was also a consumption of 25,000 tons of industrial gas oil and 12,000 tons of crude used as fuel.

Syria, like Jordan, is a non-producer and a non-refiner and consequently imports all its petroleum products, although a higher proportion in this case comes from the Lebanon. These imports in 1953 represented the largest single category in Syrian import trade, costing the country £S.39·5 million.[9] In that year, domestic consumption was estimated at 414,000 metric tons;[10] by 1955 it had risen to 557,500 metric tons, of which 83,000 tons were motor gasoline, 57,700 kerosine, 234,600 industrial and automotive gas oil, and 157,300 industrial fuel oil. It will be seen that in this country the gas oil figure is large; and a sharp rise in the demand for this product in the last few years—the 1955 figure is double that estimated for 1952 and between 1953 and 1955 consumption rose by nearly 100,000 tons—seems to indicate a fairly rapid development of the Syrian economy in the industrial and transportation sectors, as does the doubling of fuel oil utilization between 1950 and 1955. Under the November 1955 revision of its transit agreement with I.P.C., Syria enjoys the benefit of purchasing from that Company a portion of the crude it may require for processing in a State refinery to meet domestic demands for petroleum products; and recent reports" indicate that the Government is now likely to proceed with its long-cherished scheme for the construction of such a plant.

Industrially and in population Egypt is the largest country under review; her domestic consumption is consequently on a much greater scale, averaging over three million metric tons in the last five years, and rising to 3,450,000 tons in 1954 and 3,750,000 in 1955.[12] This sizable supply of petroleum products is vital to Egypt, for it covers almost all her energy requirements; the railways were converted from coal to fuel oil during the war, industry has developed rapidly during the last twenty years, consumption of electricity and the consequent demand for oil for its generation have risen sharply. A high proportion of the total, therefore, is in the form of fuel oil, 2,083,000 metric tons of which were consumed in 1955; there is also a substantial utilization of diesel oil and gas oil, amounting to 422,000 metric tons. And since the Egyptian peasant is largely dependent on kerosine for both lighting and cooking, the consumption of this fuel at 798,000 metric tons is actually almost seven times that in Syria, the Lebanon, and Jordan combined. Egypt's falling local production, estimated at 1,800,000 metric tons in 1955,[13] cannot meet this high demand, and she is consequently a net importer of oil. A part of this import is in the form of crude, for the combined resources of the country's refineries now substantially exceed local production; but imports also include refined products, particularly kerosine—recently obtained under barter agreements from Iron Curtain countries against an export of cotton —and lubricants, the local manufacture of which is now under examination.[14] It seems likely that Egyptian imports will continue to run at between one and two million tons per annum unless exploration now being undertaken is strikingly successful.

More fortunate is Iraq, where an expanding economy is matched by an adequate supply. As the country develops, its internal consumption of petroleum products is bound to increase: the widening network of roads will mean more vehicles, the growing prosperity more railway traffic; a general rise in the standard of living will increase domestic consumption of kerosine; industrialization will involve further consumption of fuel oil, and so also will the demand for more thermally-generated electric power. Thus the upward trend of the country's consumption, which rose from an average of 125,000 metric tons in the years 1927-1933 to 560,000 tons in 1950 and 795,000 in 1953[15] is likely to continue. With the construction of the million-ton Durah refinery and the Qaiyarah bitumen plant, the country can more than meet all its domestic requirements of petroleum products except lubricating oil; and this too will soon be provided. Thus it is clear that Iraq can readily lay her hands on internally-produced fuel sufficient for any industrial development likely to be desirable or contemplated in the near future. Oil supplies are local and immediate, the refineries no bottleneck, and natural gas a strong line of reserve.

Energy and development

The demands of the Middle East countries for fuel are growing as the level of economic activity rises; in the case of Egypt they have outstripped local supply, and in some countries this does not exist. But the offtake from the regional output of crude, even with increasing industrialization, is unlikely to be ever more than a mere fraction of supply; and refinery development to meet local needs is merely a matter of adjustment. Moreover, there exists in natural gas another source not only of fuel but of industrial raw material, the use of which has been receiving increasing attention in the past few years. It is not proposed to consider here the schemes which have been suggested for the sale of this gas to

Western Europe: not all of it is, of course, available for export; some is used in the active operations of the companies and some may be required for pressure maintenance in the fields. But whether gas is exported or not, there is likely to be an ample supply left for local use as a raw material or energy source. Some utilization is indeed proceeding or planned now; as early as 1952, Anglo-Egyptian Oilfields sold 14,200 metric tons of purified gas to the fertilizer industry in Egypt,[16] and the erection at Kirkuk of an immense factory to produce from the natural gas of that field as much as half a million tons of ammonium sulphate, 100,000 tons of elemental sulphur, and 300,000 tons of cement per annum, was envisaged by the International Bank.[17] It was also recently reported that a company had been set up in Saudi Arabia to use natural gas for industrial and other purposes.[18] The larger producing companies already utilize gas as far as possible in the generation of electricity, the distillation of water, and for domestic purposes; and directly or indirectly this source of power is often also available to local consumers: thus in Kuwait the gas is piped to the nearby city for its power-house and distillation plant.

It would seem, therefore, that the Middle East will have ample fuel to permit that increase in the consumption of energy *per capita* which is generally closely related to a rise in living standards. Industrialization is not the only element in this, though it may be of immense importance in those countries which are over-populated in proportion to their agricultural potential; nor must it be indiscriminate: the Middle East countries would be wise to concentrate on those industries which process the production of local agriculture, utilize such minerals as exist, are immediately necessary for development programmes, or stop up an obvious gap in the balance of payments. Where such industrialization is necessary, it can only be accomplished with the aid of oil and gas, the only cheap and abundant fuels which are found locally.

References

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[2] Jackh, E., "Background of the Middle East", p. 174.
[3] United Nations, "Review of Economic Conditions in the Middle East, 1951-52", p. 62.
[4] *Ibid.*, p. 63.
[5] Bahrain Petroleum Company, Annual Report for 1954.
[6] The recent figures quoted for Syria, Lebanon, Jordan, and Egypt are from a reliable source, and are considered accurate; other figures for earlier years will be found in the United Nations publication, "Economic Developments in the Middle East, 1945-1954", pp. 158-159 (Lebanon only), and *I.P. Review*, 1956, **10**, 45, extracts from "World Petroleum Statistics—1954".
[7] United Nations, "Economic Developments in the Middle East, 1945-1954", p. 166.
[8] See 6 above for sources.
[9] United Nations, *op. cit.*, p. 194.
[10] See 6 above for sources.
[11] *The Times*, 29 Nov. 1955, Reuter 8 and 24 Feb. 1956.
[12] For sources of figures other than of crude, see 6 above.
[13] Table IV in Part II of this study.
[14] *Petroleum Press Service*, June 1955, p. 221.
[15] United Nations, *op. cit.*, p. 97.
[16] Anglo-Egyptian Oilfields Ltd., Report and Accounts for 1952.
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Petroleum in Parliament

Atmospheric Pollution by Refineries

At Question Time in the House on 2 March Mr Braine asked the Minister of Housing and Local Government from which local authorities during the last three years he had received complaints and requests for action concerning the pollution of the air by Thames-side oil refineries; what steps had been taken to abate the continued pollution of the air of South-East Essex by these oil refineries; from which local authorities it had been represented to him that the continued pollution of the air of South-East Essex by the Thames-side oil refineries was detrimental to health, and what steps were being taken to conduct research into the effect of this pollution on health.

Mr Sandys replied that during the last three years he had received representations about air pollution from these refineries from the Council of the County Borough of Southend and the Urban District Councils of Rayleigh, Benfleet, Canvey Island, and Sheerness. The Southend Council had expressed anxiety about the effect of the pollution on health.

Mr Sandys went on to say that the refineries were all registered under the Alkali, Etc., Works Regulation Act, 1906. They were inspected regularly by his alkali inspectors, and he was advised that all practicable steps were being taken, as the Act required, to prevent the emission of noxious or offensive gases.

It was not practicable to eliminate the pollution and unpleasant smells entirely, but he was advised that such emissions as occurred were not detrimental to health.

The Price of Oil—*continued from page* 124

A year or two ago, the Canadians built a new pipeline to carry crude from Alberta to that area, to be refined in the State of Washington; new refineries were erected, and one of those refineries, which was built with the object of using this Alberta crude, ran 50:50 on Alberta crude and Venezuelan crude. The refiner in question had, of course, production in Venezuela, as well as in Alberta, and I think that what may have been a relevant factor, was that he only had to take into account, or was most concerned with, his out-of-pocket expenses, rather than posted prices.

Mr Pattman: I do not think one really has to seek an occult explanation with regard to the North West United States refineries. That is not the only instance of an imported crude going into the U.S. West coast; there is Middle East crude going in too. You can see in terms of regularly published prices and freights that, in fact, Alberta crude, at its present posted price which is set mainly by reference to local disposal, is not very attractive to refiners in the Pacific North West of the United States, and you will not stop this movement of sea-borne imported crude, whether it is Venezuelan or Middle East crude into the Pacific North West until the producers in Canada are willing to reduce their posted price or until the pipeline operation across the Rockies is carried out at a lower tariff rate, which assists the Alberta oil to find its way there.

I think the trouble is that Alberta crude is barely competitive in that area—it is all right inside Canada, but it is barely competitive in the U.S. Pacific North West.

Butt Welding of High Pressure Pipelines

A new Automatic Process

The Burton pressure butt welding process was initially developed to overcome production bottlenecks in quality pipe welding and employs the novel principle of allowing the plasticity of the steel being welded to control its own welding cycle. Development work on this process was commenced in 1947 at H.M. Dockyard, Rosyth, and later at the Central Metallurgical Laboratory, Emsworth, and H.M. Dockyard, Portsmouth.

Essentially, the process consists of bringing the faces to be joined together under a minor load and heating by means of a multi-jet oxy-acetylene oscillating ring burner until a pre-set thermal expansion is reached. A second higher or control load is then applied to return the pipe to its original length, when the final butting pressure operates to complete the weld. All sequences are controlled automatically by limit switches

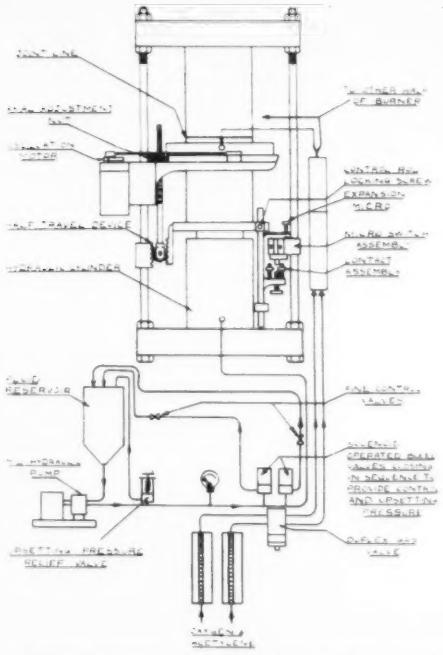

Fig 1. *Control system of pressure butt welding machine*

which are also arranged to control upset and to cut off the gas supply just before completion of the weld.

The system of control is shown schematically in Fig 1. It will be noticed that the welding operation is controlled by a rod, carrying the limit switches, locked to the moving part of the machine, which by recording linear dimensional changes causes the welding sequence to occur. Welding temperatures are not measured but may be systematically varied by alteration of the control pressure; raising the pressure reduces and lowering increases weld temperature. Working pressure limits for the production of satisfactory welds are generous and welding times lie between 45 sec and 4 min according to pipe wall thickness.

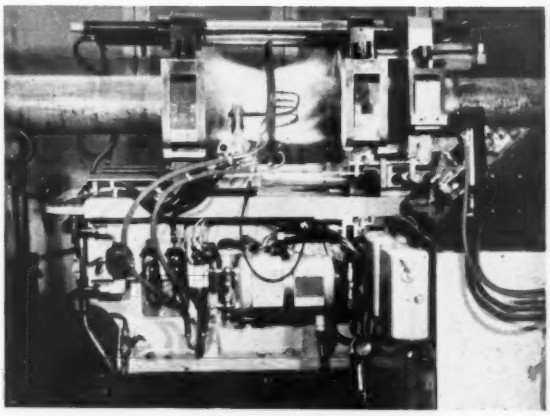

Fig 2. *The Portsmouth machine making a pipe-to-pipe weld on 8-inch o.d. pipe*

Two practical machines using these principles have been constructed, one for shop use and the other a prototype portable model. The development of the portable machine was undertaken in view of the particular advantages foreseen in the application of this process to the welding of pipes on site and in positions of limited access. The "shop" model can be adapted as a transportable machine.

The Portsmouth "shop" machine is shown in Fig 2 and by the use of different size ring burners and collet holders has been constructed to weld pipe-to-pipe and pipe-to-flange in sizes from 3 to 8 inches o.d. for wall thicknesses between $\frac{3}{16}$ and $\frac{3}{4}$ inch. Provision has also been made for tube turn-to-pipe and tube turn-to-flange welds.

The portable machine for pipes $1\frac{1}{2}$ to $2\frac{1}{2}$ inches o.d. and $\frac{1}{4}$-inch wall thickness is shown in Fig 3 and consists of three separate units, the welding head, the hydraulic cabinet, and

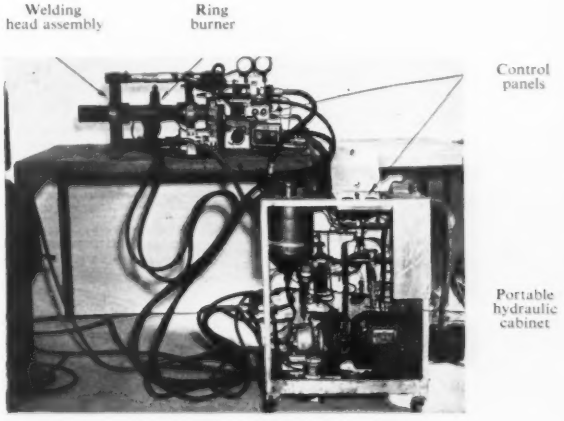

Fig 3. *General arrangement of the portable machine*

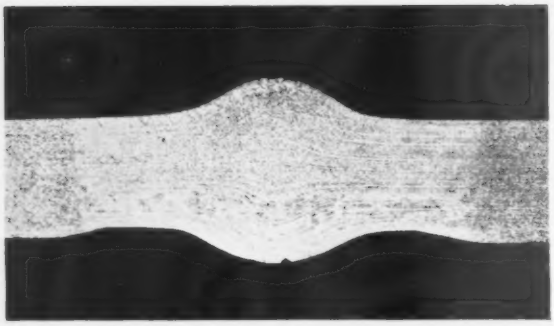

Fig 4. Macro-etched section of 8-inch o.d. pipe-to-pipe weld showing grain flaw

the connecting leads. The design is such that the welding head may be assembled round the pipe in any position.

In both machines an oxy-acetylene flame on the reducing side of neutral is used and commercial flow meters and a back flash arrester are fitted in the gas supply, which is by manifolded cylinders of oxygen and acetylene. Burn back arresters are fitted direct to each half of the ring burners. Joint preparation consists of a fine machined bevel finish with mating faces on the bore of the pipe. Weld upset is controlled to be between 50 and 60 per cent and no subsequent machining of inside or outside reinforcement is required as significant edge weaknesses are absent. A macrosection of a completed 8-inch dia pipe-to-pipe weld illustrating grain flow is shown in Fig 4.

Welding has been confined to mild, carbon-molybdenum and chromium-molybdenum steel pipes but there does not seem to be any reason why more highly alloyed pipe steels cannot be joined by this process. Post-weld heat treatment is a requirement and consists of normalizing for mild steel pipes and normalizing and tempering for low alloy steels where air hardening tendencies are present. Straight normalizing may be carried out on the machine but tempering heat treatments require additional equipment.

Bend tests with either the inside or outside reinforcement removed have been used for test purposes during development. Such tests have proved to be most discriminative and readily capable of detecting inside or outside edge weakness at the weld line. For production control the removal of a small amount of reinforcement in the form of a chip $\frac{1}{16}$ inch thick is practised; a surface defect will cause the chip to part at the weld line.

The weld line is not usually distinguishable by normal etching methods but may be shown to be richer in oxygen than the adjacent parent metal. Such zones have similar properties to the parent pipe and are regarded as acceptable provided surface metallurgical notches are absent.

Apart from pipe welds the possibility of using this process for other highly stressed components such as gas cylinders and small pressure vessels should not be overlooked. It should be emphasized that the process is fully automatic and apart from the necessity of ensuring correct setting of the machine and occasional consistency checks, highly skilled operators will not be required. Accordingly time saving over manual or automatic metal arc welding may be expected to lead to considerable economies.

The Burton process is covered by B.P. 706406* and was originated by J. E. Burton, a dockyard technical officer, who has been appointed as technical adviser on the development of the process on the machines that now bear his name.

* Owned by the National Research Development Corporation. Enquiries regarding licences should be addressed to the Exploitation Officer, 1 Tilney Street, London, W.1.

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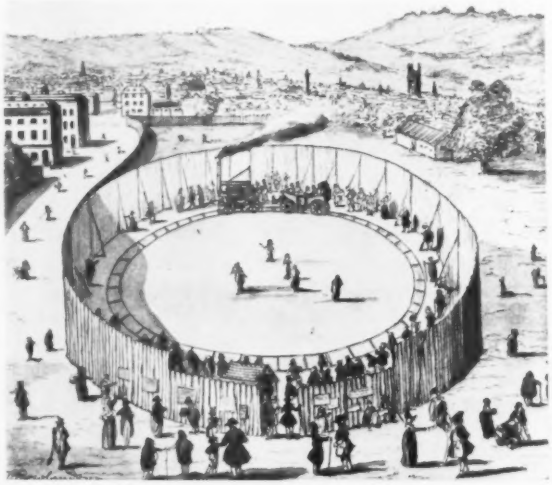
UNIVERSITY COLLEGE ENGINEERING DEPARTMENT

In the middle of February, University College, London, launched an appeal for assistance from British industry towards a £2 million project for training more engineers in the U.K. to help overcome the shortage of qualified technicians.

In announcing the plans, Lord Strang said that if the ultimate goal could be reached they would be able to send out 200 trained engineers every year instead of the present 70. As soon as £300,000 has been raised the first stage of the building programme can be completed and the output of graduate engineers increased by 50 per cent.

Already many firms in the petroleum industry have contributed to the appeal, the list on 1 January including the following: Alfa-Laval Co Ltd; Babcock & Wilcox Ltd; E. B. Badger & Sons Ltd; The British Petroleum Co Ltd; The Burmah Oil Co Ltd; The English Electric Co Ltd; Esso Petroleum Co Ltd; Foxboro-Yoxall Ltd; W. J. Fraser & Co Ltd; G. A. Harvey & Co (London) Ltd; Head, Wrightson & Co Ltd; The Lummus Co Ltd; Procon (Great Britain) Ltd; The Shell Group of Companies; Trinidad Leaseholds Ltd; Whessoe Ltd.



This Rowlandson print shows the first passenger railway in the world. Designed by Trevithick, it preceded the Engineering Department of University College, London, on its present site.

Trade Literature, etc.

Corrosion Inhibitors

The National Aluminate Corporation, Chicago, manufacturers of corrosion inhibitors, has established a distributing agency in London at 2 Broad Street Place, London, E.C.2. The Company's products are now manufactured in Europe.

Light Foam-making Branchpipe

A foam-making branchpipe, 18 inches long and 6¼ lb in weight, has been developed by The Pyrene Co Ltd for use in fighting fires involving bulk quantities of oils, spirits, and other inflammable liquids.

The branchpipe can be used to project either water or fire-smothering foam.

Refinery Fittings

A new type of return bend, Type 1500, has been added to the Osborn-Ohio range of refinery fittings manufactured by Samuel Osborn & Co Ltd of Sheffield. The fitting is suitable for a wide range of operating pressures and temperatures and incorporates a number of important new features.

KEL-F Elastomer

Details of KEL-F Elastomer, a heat- and corrosion-resistant fluorocarbon rubber, are given in a booklet available from The M. W. Kellogg Company, Chemical Manufacturing Division, P.O. Box 469, Jersey City 3, N.J.

The elastomer's applications include heat- and chemical-resistant hose, tubing, seals, tank linings, etc.

New Automatic Tank Gauge

A leaflet now available from Whessoe Ltd, Darlington, gives details of the new ST-8000 automatic tank gauge which that Company is now manufacturing under licence from the Shand and Jurs Company of California, U.S.A.

Forward Lubricants

The Forward Oil Co Ltd has announced a change of name to Forward Lubricants Ltd.

Forged Steel Valves

A new catalogue of forged steel valves has been published by Newman, Hender & Co Ltd, Woodchester, Stroud, Glos.

Acoustol Oils Ltd

V. L. Farthing & Co Ltd, lubrication technologists, have recently formed a separate company, Acoustol Oils Ltd, to deal with the sale of their "Acoustol" lubricants.

Refractory Concrete

Two new leaflets have recently been published by the Lafarge Aluminous Cement Co Ltd. They deal with the use of refractory concrete for foundry floors and for the construction of monolithic underground flues in place of brick-built flues.

Copies of these leaflets are available from the Company at 73 Brook Street, London, W.1.

New Foxboro-Yoxall Controller

A new development in pneumatic precision control instruments, M 58, has been announced by Foxboro-Yoxall Ltd. This adds to the Company's Consotrol range of control instruments. It provides four control actions: proportional, proportional-derivative, proportional-reset, and proportional-reset-derivative.

Full information about this new instrument can be obtained from Foxboro-Yoxall Ltd, Lombard Road, Merton, London, S.W.19.

Wilson-Snyder Pumps

Three booklets dealing with Wilson-Snyder centrifugal pumps, plunger pumps, and piston pumps have recently been issued by the Oil Well Supply Company. These booklets give specifications and performance characteristics and are numbered respectively 19, 20, and 21. Copies may be obtained from the Company at 5 Queen Street, London, E.C.4.

Robertson Thread Gauge

Published by W. H. A. Robertson & Co Ltd, of Lynton Works, Bedford, "The Robertson Guide to Screw Thread Forms of the World" is a comprehensive and useful compilation. Sixty screw thread forms are illustrated and dimensioned and an index also provides details of the appropriate standard number and abbreviation. Copies are available from the Sales Manager on application.

This six-cylinder diesel engine tanker, which has a capacity of 1500 gallons, is one of two vehicles which have recently been shipped to British West Africa by Seddon Diesel Vehicles Ltd.

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CRUDE OIL PRODUCTION

	Jan.	1956 *Feb.*	*Jan.-Feb.*
		Tons	
Iraq Petroleum Co Ltd	2,057,671	1,753,450	3,811,121
Basrah Petroleum Co Ltd	737,830	647,797	1,385,627
Mosul Petroleum Co Ltd	106,389	98,570	204,959
Qatar Petroleum Co Ltd	481,819	475,134	956,953

	Feb.
	Brl
Trinidad Petroleum Development Co Ltd	327,959
Kern Oil Co Ltd:	
California	100,583
Trinidad	84,608

Notes of the Month

Oil Storage Changes at Stanlow

Considerable ingenuity was called for at Shell's Stanlow refinery recently when it was decided that 10 large storage tanks, each weighing approximately 300 tons and capable of holding 9000 tons of oil, were obstructing plans for expansion and must be moved to a new site some 500 yards away.

Three different methods of removal had to be employed. Four of the tanks were skidded on rail tracks by diesel-driven trucks, a fifth was cut into sections and re-erected by welding on to its new foundation, and the remaining five were floated to their new positions along a specially-built canal.

The floated tanks near their final location.

A Shell photo

The canal which was built was 50 yards wide and 500 yards long, connecting the old and the new tank compounds. To fill it 24 million gallons of water had to be pumped from the nearby River Gowy. At high tide the tank compounds and the canal were flooded to a depth of 3 ft 6 inches, ropes were attached to the tanks and they were hauled along by a team of men.

When the new positions were reached, anchors of steel pipe were dropped into the water and frogmen helped by fixing the exact sites of the tanks from underwater. Once positioned, the tanks were allowed to sink on to their new bases, and the canal was drained and demolished.

Aerial Survey in Saudi Arabia

An American mapping organization—Aero Service Corporation of Philadelphia—has started work on a 200,000 square mile aerial survey of the Shield Area of Saudi Arabia.

This area is believed to be potentially rich in minerals and the survey will speed King Saud's programme of natural resources development. The survey is being financed wholly by the Saudi Arab Government and is expected to be completed in 1957.

Electronic Brains help Chemical Engineers

Million dollar "electronic brains" are now helping chemical engineers solve complex problems involved in producing synthetic fibres, wonder drugs, detergents, synthetic rubber, plastics, and many other everyday miracles of the chemical industry, according to Arthur E. Hoerl of the Du Pont Company who spoke at the recent 33rd National Meeting of the American Institute of Chemical Engineers.

Lightning speed calculations are possible with the large-scale computers that are now becoming more common wherever complex technical problems need solving. There are many of these types of problems in the chemical and petroleum industries where research and production calculations may ordinarily require thousands of hours. "Electronic brains" go to work and give the answers, sometimes in minutes.

Various aspects of machine computation were discussed by other speakers.

New Storage Tank Device

A new system of preventing vapour loss in large petroleum storage tanks is now being used in tanks built by Wm. Neill & Son (St Helens) Ltd, under licence from the Hammond Iron Works, U.S.A.

The device has been incorporated in two million-gallon tanks recently built for the Mobil Oil Company's Coryton refinery. Each tank is fitted with a skin steel floating roof which rests on the surface of the petroleum product. Between the floating roof and the tank wall is fitted an 80-ft-diameter-tyre of nylon fabric coated on each side with butadiene acrylonitrile synthetic rubber. This is partly inflated with liquid and secured to the floating roof of the tank, thus preventing vapour from forming, and acting as a seal between the floating roof and wall of the tank. The rubber tube is protected with a synthetic rubber scuff band and rises and falls with the steel roof on the level of the petroleum.

New French Tanker

The shipping organization of Société Française des Pétroles BP, has ordered its fourth 33,000-dw-tanker in recent years. Two tankers of this size, *Chambord* and *Chenonceaux* were launched early last year, and a third, *Cheverny*, is to be launched in June this year. The fourth tanker, which will be named *Chaumont*, is scheduled for launching in 1958.

Recent expansion of the French Company's tanker fleet was aided by the transfer of three 16,000-ton T2 tankers from the British Tanker Company—BP's shipping organization.

New Esso Motor Oil

A new all-season motor oil, Esso Extra Motor Oil, is now being marketed by the Esso Petroleum Company in two grades to suit different types of engine.

The new oil is said to combine stability under differing temperatures with particularly effective lubrication of surfaces where a fluid film cannot always be maintained.

The oil is said to have no marked scouring action to loosen existing deposits and maintains engine cleanliness by preventing sludge from forming rather than by dispersing it.

New Units for Antwerp Refinery

Kellogg International Corporation is to design and construct a combined catalytic desulphurizer and catalytic reforming unit for Raffinerie Belge de Pétroles, Antwerp. Sinclair-Baker RD-150 platinum reforming catalyst will be used in the new unit.

Thermal Reforming Unit at Aden

A 400,000 tons a year thermal reforming unit is to be built at British Petroleum Company's Aden refinery so that the refinery's production of high-grade motor spirit can be increased.

Work is also being carried out to extend the refinery's cooling water supply. The installation of new pumps and pipelines will enable the quantity of cooling water circulated through the refining units to be increased from 2,000,000 gallons to 3,000,000 gallons an hour.

Oil Traffic at Stanlow

At the recent General Meeting of the Manchester Ship Canal Company the Chairman, Sir Leslie Roberts, C.B.E., said that the oil traffic at Stanlow had outgrown the capacity of the oil docks and canalside berths there. A scheme for extensive new berths was under examination and power was being sought to construct a new oil dock, partly on land owned by the Company and partly on land to be reclaimed from the Mersey. The new dock would be connected to the oil installations on the Canal south bank by pipelines through a new subway.

New Jetty at Coryton

Expansion of production at Mobil Oil Company's Coryton refinery has led to the construction of a second ocean-going tanker jetty which is expected to come into service this summer.

The jetty is of "T" head construction and will be capable of handling most of the large tankers in use or under construction. It is being constructed near the refinery's water intake jetty.

Two breasting dolphins flank the handling platform and these provide a berthing frontage of about 270 feet. The hose handling equipment itself will be the same as that installed at Socony Mobil's Paulsboro' refinery in America.

Assam "Wildcat"

Work has begun on the drilling of a deep test well at Moran in the Assam Valley. A licence was recently granted to the Assam Oil Company for prospecting in the Moran area, which lies further down the Assam valley than anyone has previously explored by drilling. It is thought that the well may be drilled to a depth of 12,000 feet or more.

Helicopter Rescue in Doha

A helicopter of the Shell fleet of aircraft was recently diverted from operations in Doha, capital of Qatar in the Persian Gulf, to bring four seriously burned Pakistani from Dass Island to hospital in Doha, a distance of 80 miles. Without the immediate aid made possible by the helicopter all four men would probably have lost their lives.

BEA Contract for British Petroleum Company

The British Petroleum Company Ltd is to supply all the aviation fuel requirements of British European Airways for the next three years. The contract which has recently been signed covers 60 airports at home and abroad and is estimated to be worth between £8,000,000 and £8,500,000. It will involve the supplying of some 400,000 tons of aviation fuels—made up of about 330,000 tons of turbine fuel and some 70,000 tons of petrol.

Results of "Auris" Gas Turbine Tests

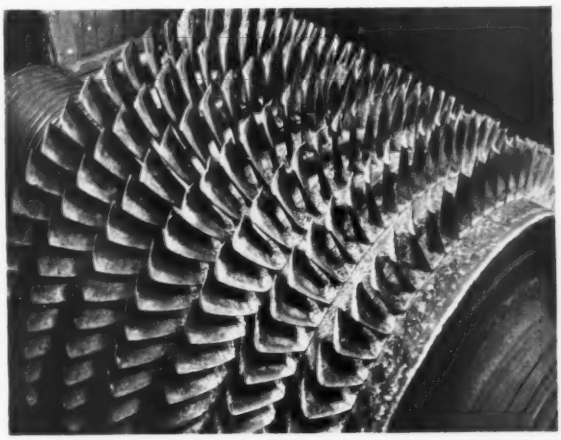
Tests with a 1200 horse-power gas turbine engine in the Shell oil tanker *Auris* have shown that it is possible to operate on boiler fuel without corrosion or fouling of the turbine blades.

The engine has been operated at full power for 17,510 hours and has now been inspected. Results have shown that the corrosion problem has been overcome and that the problem of deposition when operating on any grade of commercial boiler fuel is well on the way to solution.

Use of special materials has prevented the corrosion of parts which work at a red heat and the accumulation of deposits on the blades has been overcome by the development of a technique which removes the combustion deposits as they occur.

The shaft journals and thrust bearings were also found to be in excellent condition on inspection.

Further development work is now to be carried out with a new British Thomson-Houston 5500 horse-power turbine which is to be installed in the *Auris*. Particular attention is to be paid to ensuring good manoeuvring capabilities.



A Shell photo

Close-up of rotor of the Auris *as removed from its casing. In the foreground the high-pressure row.*

CBMPE Activities

Reporting on the activities of the CBMPE during the second half of 1955, G. V. Sims, the chairman, records that in the period membership increased by 5 to a total of 411. The Overseas Advisory Committee has inaugurated informal discussions with representatives who have recently visited overseas areas and four discussions have been held on the Middle East (2), on South America, and on the West Indies.

A report by the Council's technical adviser, T. L. Bonstow, indicates that in the field of standardization considerable progress has been made in the revision of existing BS specifications and in the preparation of new ones.

Novel "Story of Oil" Exhibit

A novel exhibit telling the story of oil in various stages was shown by Shell at the Utrecht Trade Fair in March. Twenty moving models are used in the electrically-operated exhibit to trace the progress of oil from the arrival of a tanker in dock to the everyday applications of finished petroleum products.

Based on a table 22 ft in diameter, architectural and moving models unfold and are added to by more models from beneath the table surface. A refinery, a tank farm, a factory area, farmlands with an airport, a built-up area, and a gasoline service station appear in succession, synchronized with a running commentary.

The finale consists of a flight around the table by a model of a Vickers Viscount or a Bristol Britannia propelled by compressed air and controlled by a central pivot mast.

The exhibit is to be shown all over the world and the commentary can therefore be adapted to any language and the scenes varied to portray temperate, sub-tropical, or tropical zones.

New Jetty for Llandarcy Tankers

A new coastal tanker jetty costing £600,000 has been brought into use at Queen's Dock, Swansea, where the waterborne traffic of B.P.'s Llandarcy refinery is handled.

The new jetty is 600 feet long by 30 feet wide and is provided with 20 storage tanks. It has two berths at which

A BP photo

The Mayor of Swansea operates one of the valves of the new BP tanker jetty at Queen's Dock, Swansea.

tankers up to 1200-tons capacity can load petroleum products for distribution to coastal depots, and two lay-by berths for tankers waiting to load.

Principal users of the jetty will be the Shell-Mex and B.P. fleet of nine tankers specially designed for estuarial work which is now under construction.

ACHEMA 1958

The 12th Chemical Apparatus and Equipment Congress and Exhibition is to be held in Frankfurt am Main from 31 May to 8 June 1958.

Iranian Production Figures

January production of crude oil in South Iran by Iraanse Aardolie Exploratie en Productie Maatschappij, N.V., amounted to 1,479,000 long tons. Refinery throughput at Abadan by Iraanse Aardolie Raffinage Maatschappij, N. V., was 570,000 long tons for the month of January.

February figures for the two Companies were: production, 1,649,000 long tons, giving a total for the two months of 3,128,000 long tons; refinery throughput, 797,000 long tons, giving a total of 1,368,000 long tons.

Money for the Expanding Chemical Industry

Hamilton R. Wager, Arabian American Oil Company, speaking at the recent meeting of the American Institute of Chemical Engineers, described in some detail the advantages to be gained from using appropriation requests for money to finance new development.

"Effective control and thorough evaluation of all capital expenditures is a vital responsibility of business management" stated Mr Wager. "Probably nowhere is this more true than in the chemical and process industries with their peculiar problems of obsolescence due to rapidly changing technology".

He discussed the importance of establishing a formal means of communication, the appropriation request, between top management purse strings and lower originating echelons. Each new idea or project must be presented to the authorizing officials in a readily understandable form, he said.

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PRIZES FOR NAVAL ARCHITECTURE

The Institution of Naval Architects makes an annual award of the Samuel Baxter Prize (or prizes) for the best contribution during the year towards safety and or efficiency in sea-going vessels.

The work submitted must take the form of a paper, essay, description, or drawing of any new design, invention, process, equipment, or apparatus relating to safety and or efficiency in sea-going vessels.

Claims will be considered from any persons who wish to submit their work or who have work submitted on their behalf.

Submissions must be received by the Secretary of the Institution of Naval Architects by 31 December 1956.

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SITUATIONS VACANT

Air Ministry Works Designs Branch requires in London designer/draughtsmen for bulk petroleum storage and pumping installations experienced in one or more of the following:—(*a*) Storage tank layout and design (*b*) pumphouse and plant layout (*c*) development of pipeline schemes (*d*) hydraulic calculations. Technical training to O.N.C. standard required. Salaries up to £725 p.a. starting pay based on age, qualifications, and experience. Paid overtime. Long term possibilities with promotion and pensionable prospects. Normally natural born British subjects. Write stating age, qualifications, employment details incl. type of work done, to any Employment Exchange quoting Order No. Borough 1005.

Major Oil Company has vacancies for Production Assistants in the Lubricating Grease Department at its Works in London and the North West. These positions call for graduate **Chemists** or **Chemical Engineers** and the Company is prepared to train newly qualified men for these important positions. The training is designed to enable the successful applicants to give technical process advice in the Manufacturing Departments.

There are good opportunities for promotion in the Company and a good commencing salary will be paid. The Company provides an excellent Pension and Life Assurance Scheme and other employee benefits. Please write to Box No. 1106, *IP Review*, giving brief details of personal particulars, quoting ref. P.A.119.

Fuel Technologists. Graduates with a degree in Fuel Technology or in Chemistry, Chemical Engineering or Engineering, with a diploma in Fuel Technology are invited to apply for posts concerned with development work on furnace operation and temperature measurement on high temperature furnaces, both gas and oil fired.

In the glass industry, which is a major fuel consumer, interesting and rewarding jobs are available in Works at St. Helens (Lancashire) and Doncaster (Yorkshire).

Applicants should write stating age, qualifications and experience to the Personnel Officer (Staff), Pilkington Brothers Limited, St. Helens, Lancashire.

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Industrial Reconnaissance

No Planned military operation takes place without careful probing of the tactical position. Similarly no soundly conceived plan of industrial development can proceed before adequate surveys have been undertaken. So logical is this that its statement seems superfluous. Yet every year hard earned capital is wasted by drills that grind expensively into disappointing substrata. A geophysical survey, expertly conducted, greatly reduces these preliminary risks and directs the way to a speedy conclusion of the development phase.

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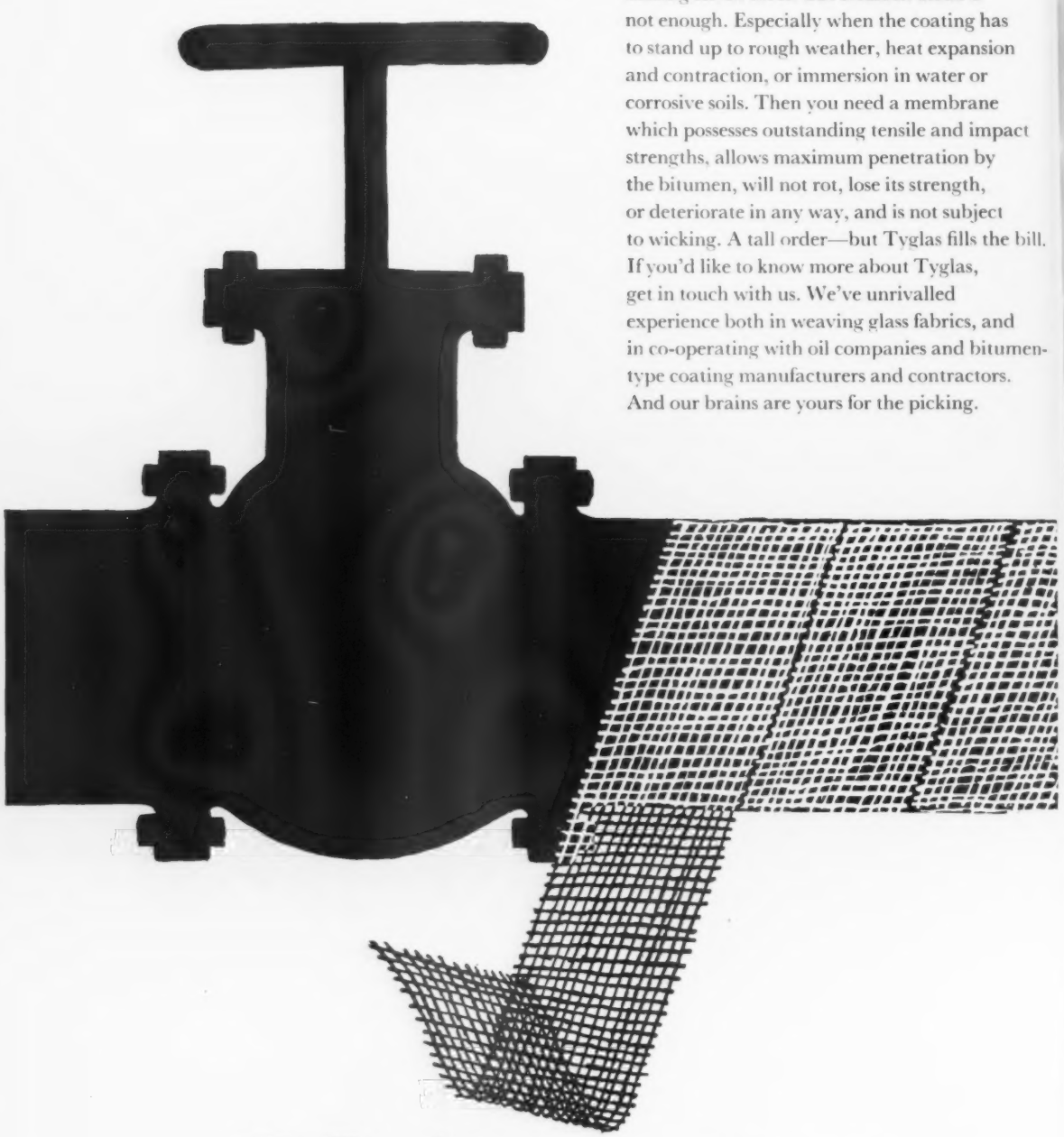
Wrapped any good pipes lately?

If it's the best reinforcement for bituminous protective coatings you're after—Tyglas is the name. Our Tyglas range of woven glass fabrics includes scrims specially designed for pipe-wrapping, waterproofing roofs, and coating marine piles.

Bitumen provides the best protective coating for all these. But bitumen alone is not enough. Especially when the coating has to stand up to rough weather, heat expansion and contraction, or immersion in water or corrosive soils. Then you need a membrane which possesses outstanding tensile and impact strengths, allows maximum penetration by the bitumen, will not rot, lose its strength, or deteriorate in any way, and is not subject to wicking. A tall order—but Tyglas fills the bill.

If you'd like to know more about Tyglas, get in touch with us. We've unrivalled experience both in weaving glass fabrics, and in co-operating with oil companies and bitumen-type coating manufacturers and contractors. And our brains are yours for the picking.



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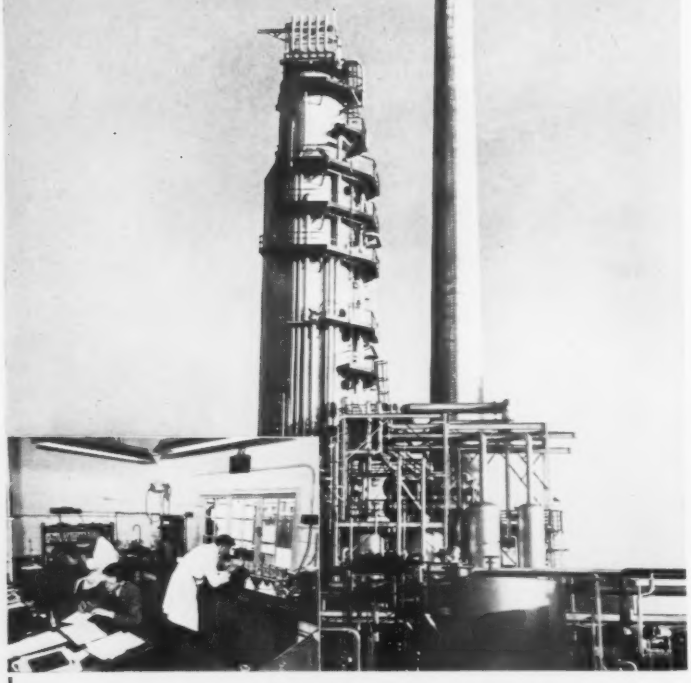

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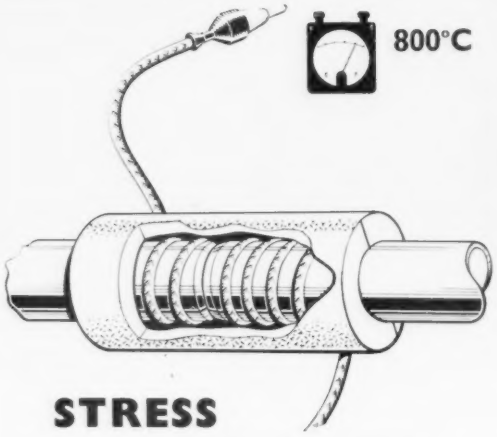

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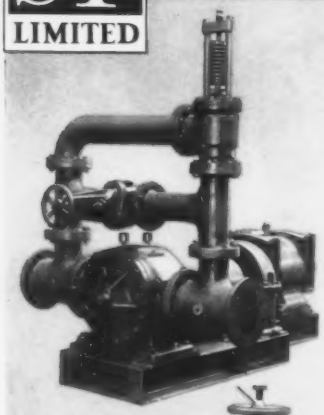
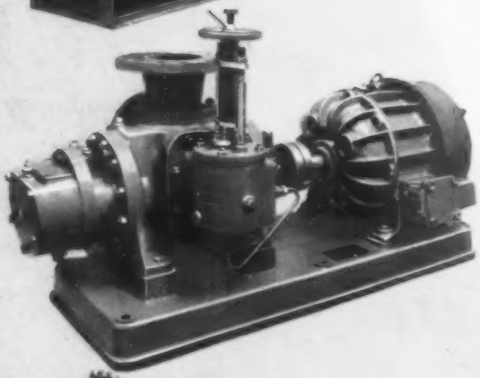
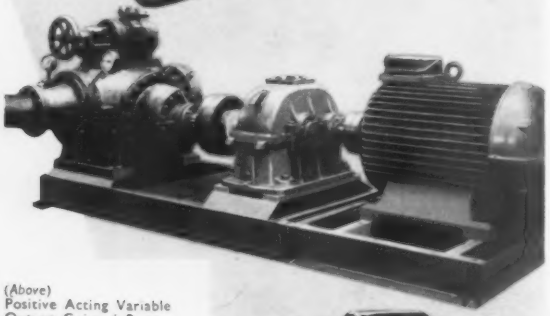


(Left)
Positive Acting Rotary Displacement Pump for the handling of Molasses and viscous fluids, electrically driven through totally enclosed Reduction Gear Box.

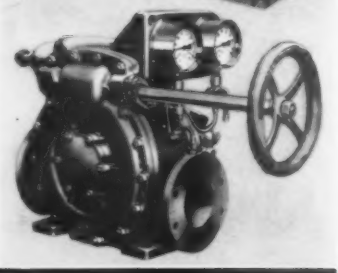
(Below)
Suitable for handling Spirits and other volatile fluids, this Screw Displacement Pump is of the all round clearance design and is capable of working with a high suction lift. The flow is practically pulseless and the unit self priming.





(Above)
Positive Acting Variable Output Guinard Rotary Piston Pump. Electrically driven through Reduction Gear Box, for Oils of varying viscosity.

(Right)
Reversing Flow Rotary Displacement Pump for fitting on tank wagons. These pumps are driven from a power take-off on the gear box.



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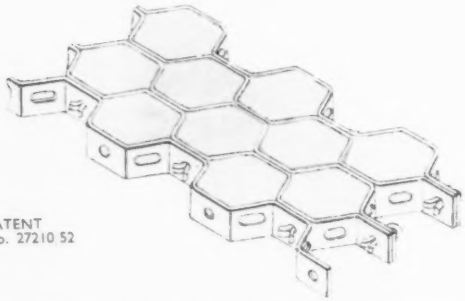

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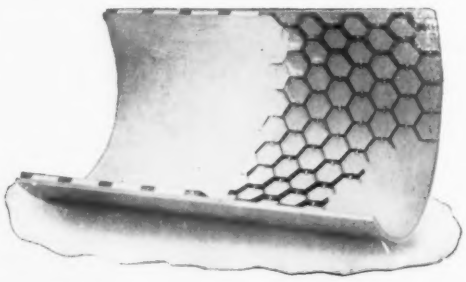

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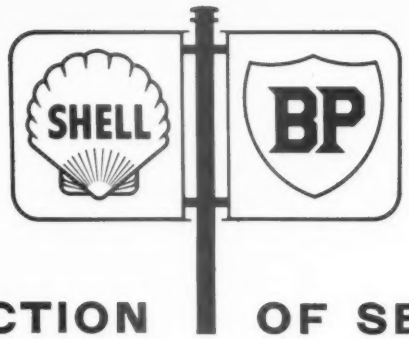

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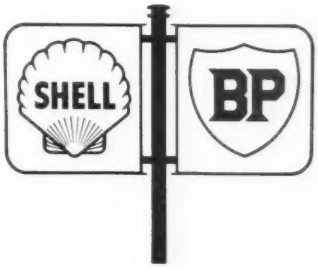

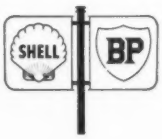

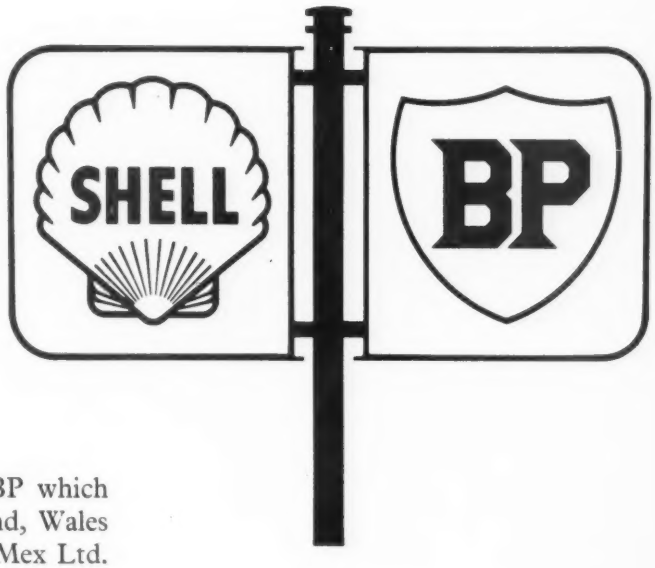

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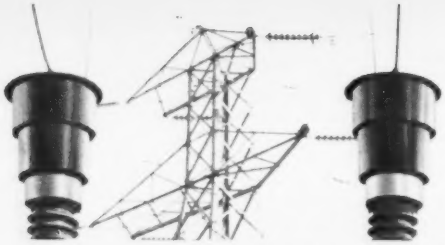

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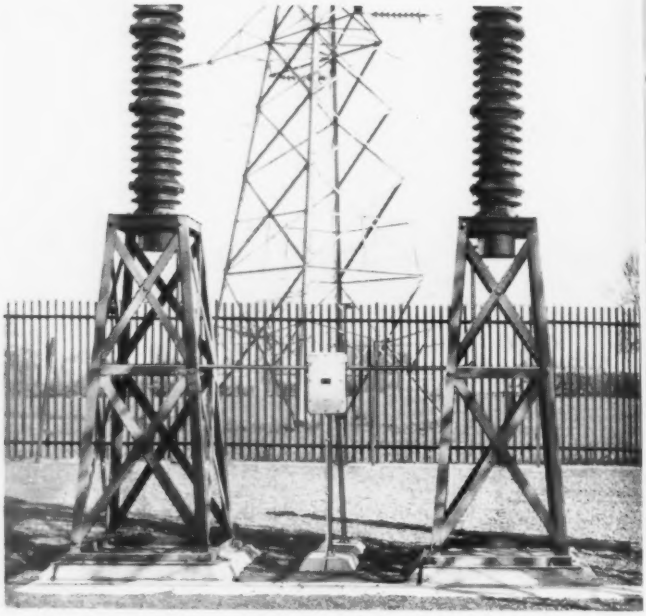

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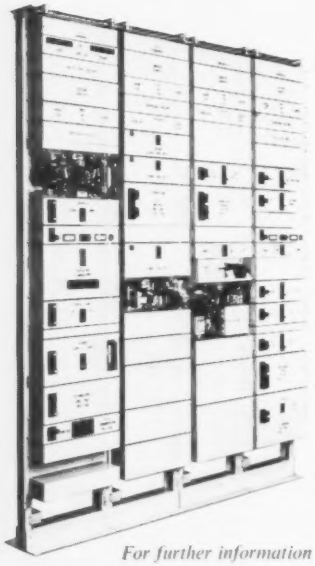

Left: Suite of power-line carrier equipment racks

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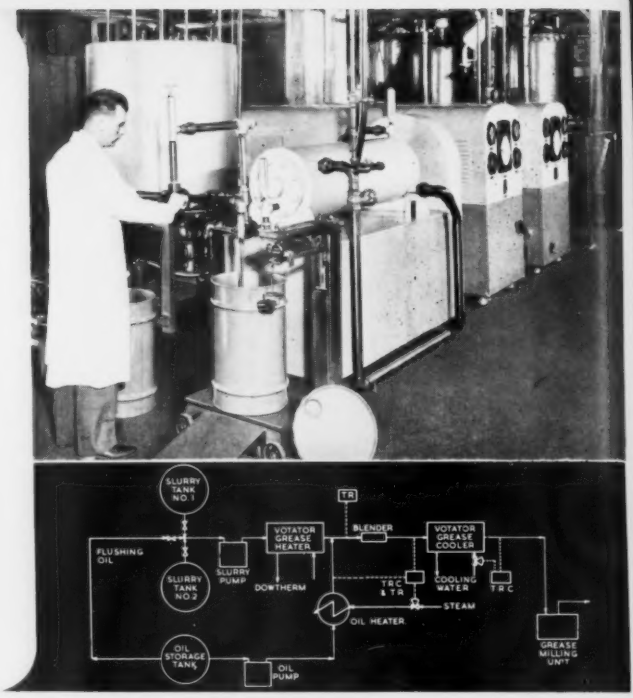

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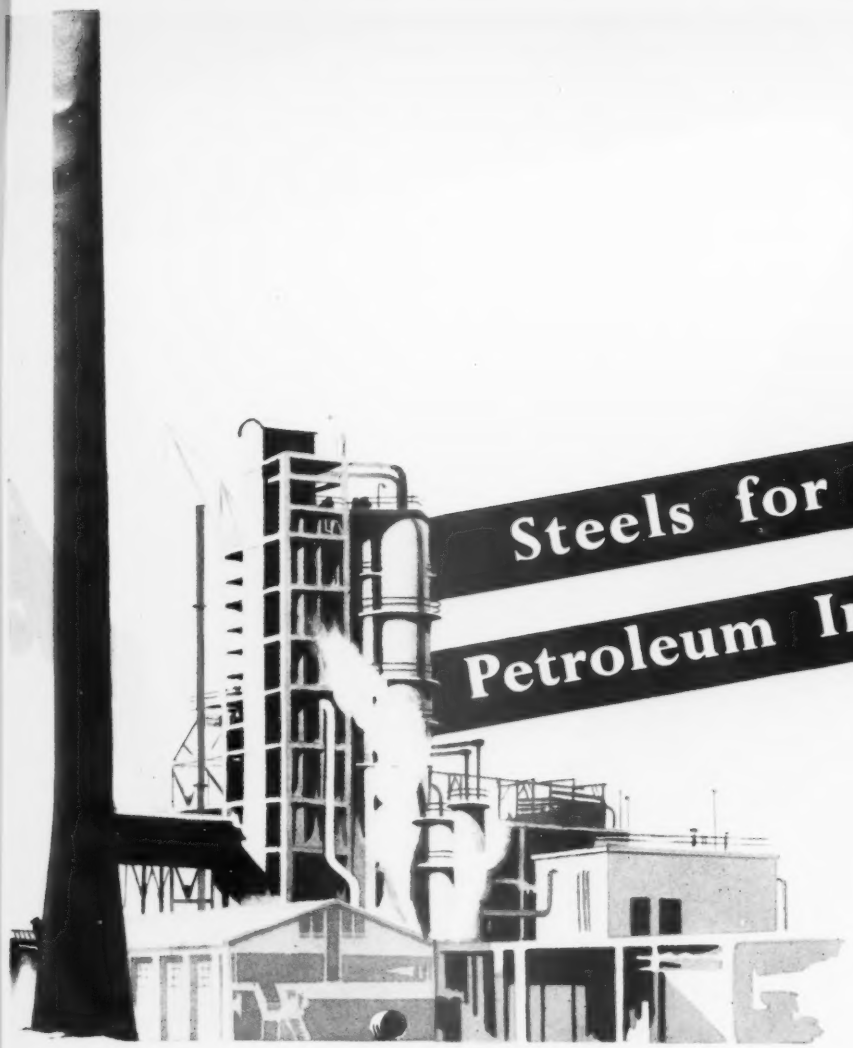

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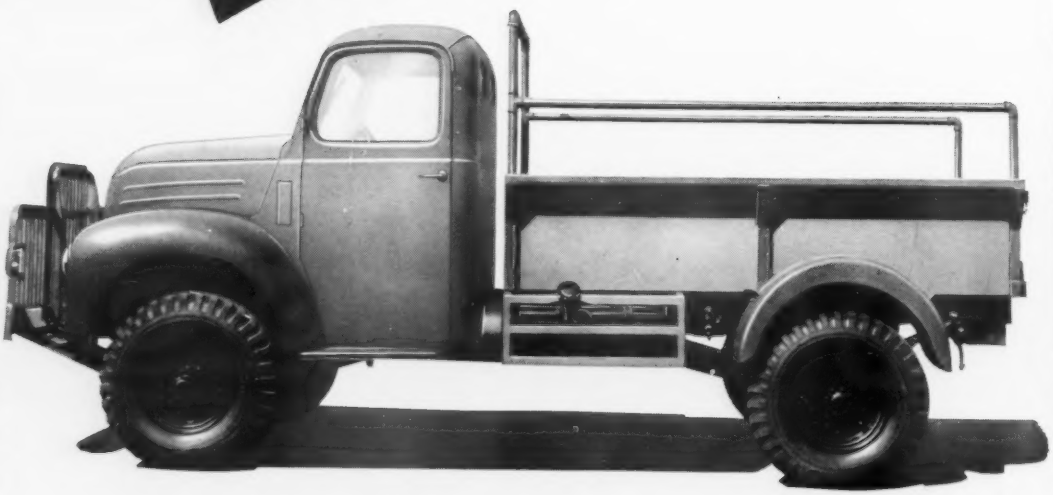

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